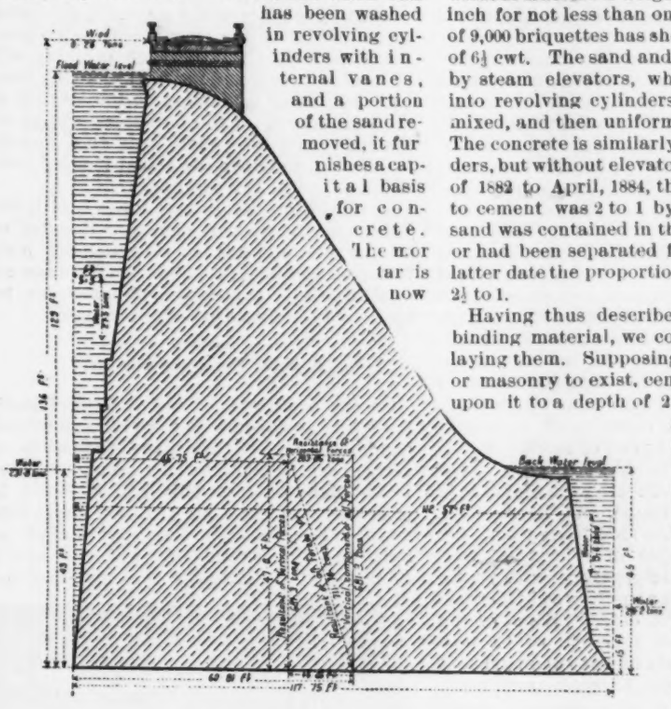
The Vyrnwy Masonry Dam.

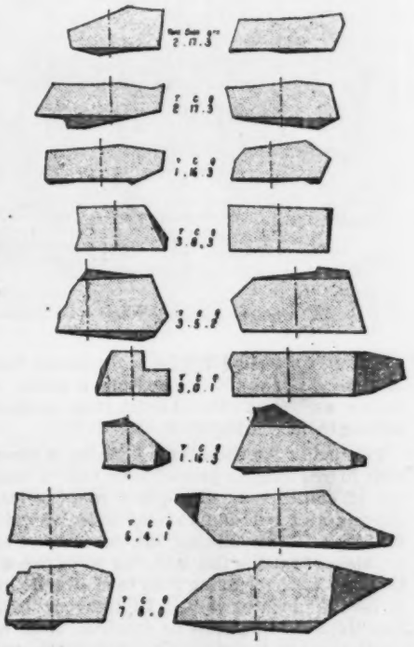
Some time ago the Corporation of Liverpool foresaw that their existing water supplies would soon become insufficient for the growing requirements of the town, a fact which has been brought home to them with unpleasant distinctness during the last summer, and they therefore set on foot a new undertaking by which they will obtain a further and immense supply from the river Vyrnwy in North Wales, by forming an artificial lake at a distance of sixty-seven and one-half miles from the existing storage reservoirs at Prescott. This lake will be 1,115 acres in extent, and will stand at a height of 825 feet above sea level, so that there will be a natural fall for the water the entire distance to Liverpool. An embankment, 1,255 long, is being thrown across the valley to impound the waters, and is being built in what is appropriately called Cyclopean rubble, for it is composed of pieces of rocks such as a race of giant masons might select to raise a fortification between themselves and their enemies. 33 per cent. of the stones weigh over four tons each, 21 per cent. weigh between two and four tons, while the remaining 46 per cent. are lighter. A clearer idea of the proportions of these massive materials may be gathered from the annexed illustration, which shows nine stones taken seriatim as they stood in the quarry. Two sections, at right angles to each other, are given of each stone. The outline shows the form it originally bore, while the stippled portion illustrates the shape to which it was dressed before being built into the wall. The quarry is situated in rock belonging to the Caradoc group of the Lower Silurian system, and produces a stone of dark gray color, weighing 2.06 tons per cubic yard, and having a specific gravity of about 2.721. The planes of cleavage are neither perpendicular to the beds nor to one another, so that no method of detachment will give stones of rectangular section. Blasting is employed to detach the masses of stone, and these are subsequently divided by plugging into pieces of a maximum weight of seven or eight tons. No attempt is made to reduce these to perfect parallelopipeds. They are dressed to a rough flat surface on the lower side, and the projecting angles are cut off at the other parts, so as to leave a compact solid figure. All the work is done with the hammer and chisel, or hammer and set. The face stones, of course, receive more exact treatment. They are all draughted to template, and have their upper and lower beds dressed parallel, and their sides dressed nearly or quite vertical. Every stone, from the largest to the smallest "random" sent to he crusher for concrete or mortar, is washed before leaving the quarry, with jets of water under a head of 140 feet, and is not passed unless perfectly clean.

This masonry dam is built on a foundation of rock of the same order as that found in the quarry. It is commonly known as clay slate, is frequently interspersed with the hard volcanic ash of the Bala series, and ranges from a close-grained grit of dark, bluish gray color, to a fine slate texture. The valley is much worn by glacial action, and as the strata dip towards the head or upper part, the outcrops have been frequently broken off and deposited in the next hollow, or have been carried away by the moving ice. These pieces, often several hundred tons in weight, were all removed and the rock cut away till a perfectly sound portion was reached. In some cases much solid rock had also to be removed to bring the edges of the various strata to an approximate level.

The materials used to bind together the large stones are cement mortar and cement concrete. The valley provides a most plentiful supply of water-worn gravel mixed with sand, clay and oxide of iron, and when this has been washed in revolving cylinders with internal vanes, and a portion of the sand removed, it furnishes a capital basis for concrete. The mortar is now made from crushed quarry refuse, mixed with half its bulk of sand, and it is found that these ingredients possess, in a degree exceedingly rare for cement mortar, the much-valued softness and absence of shortness so essential for the production of well-bedded masonry, and in respect of which quality, lime mortar has a considerable advantage over cement mortar.



Vyrnwy Dam. Cross Section.



Vyrnwy Dam. Stone Blocks.

The cement has to comply with the following conditions: 90 per cent. must be capable of passing through a sieve of sixty brass wires to the lineal inch, weighing 3¼ oz. per square foot. The tensile strength must be such that of six briquettes, eight days after being moulded, and kept in water from the second to the seventh day, one at least will sustain without fracture a weight of 5 cwt. per square inch for not less than one hour. The average of 9,000 briquettes has shown a tensile strength of 6¼ cwt. The sand and cement are measured by steam elevators, which discharge them into revolving cylinders, where they are first mixed, and then uniformly wetted by a spray. The concrete is similarly made in larger cylinders, but without elevators. From the autumn of 1882 to April, 1884, the proportion of sand to cement was 2 to 1 by volume, whether the sand was contained in the gravel for concrete, or had been separated for mortar. Since the latter date the proportion has been changed to 2½ to 1.

Having thus described the stones and the binding material, we come to the method of laying them. Supposing a flat surface of rock or masonry to exist, cement mortar is spread upon it to a depth of 2 inches over an area about the size of the stone to be laid, and is beaten to expel the air. The stone is then lowered by the crane and is hammered with heavy mauls to drive the mortar into all the inequalities, much of it being pressed out around the edges and gathered up for use again. The next stone is laid close to, but not touching the first, and so on until several are in place. The spaces between the stones are filled with concrete thoroughly rammed down and forced into the crevices with blunt swords. In order to secure thorough homogeneity, the macadam-sized stones are not added to the concrete in the machine, but are rammed into it in place. A loose layer of concrete, 2 or 3 inches thick, is laid down, and over it the broken stone is scattered and beaten into position. Then follows another layer of stone and another of concrete, and so on, the layers of stone becoming imbedded under the action of the rammers. When the interstices are sufficiently large, they are built up with smaller stones, instead of with concrete only, and so carefully has this been carried out, that an endeavor to find a space between the stones of 12-inch cube has proved futile. The work within reach of each crane is carried on to a height of 6 or 8 feet before the crane gantry is moved. It will thus be seen that the dam is one mass, which may vie with ashlar in its solidity. The front face, for a depth of a few feet, is laid in mortar, in place of concrete, in order to secure greater water-tightness.

At the request of the Water Committee of the City Council of Liverpool, Mr. George F. Deacon has made an inquiry into the stability of the embankment, and has embodied the result of his researches in a report to which we are indebted for these details. In this he has made an investigation of the distribution of pressure at the base of the wall, produced by the weight of the structure itself, combined by the lateral pressure against it, and any other pressure which may be imagined to be possible. Also of the effect which may be conceived to be due to intrusive water under pressure from the reservoir or the surrounding hills. A typical cross-section of the wall is given in the figure above. Its area is 8972 square feet; its weight, 1 foot thick, 644.2 tons; the length of the base line O X, 115.75 feet; its centre of gravity is 47.59 feet above the base, and is in a vertical line cutting the base at a distance o

47.53 feet from the inner toe O, and of 70.22 feet from the outer toe X. Assuming the lake to be empty and the wind to be blowing up the valley with the force of 40 pounds to the square foot, then the centre of pressure will be removed 24 feet nearer to the inner toe, and the vertical component of the whole pressure will be 645.2 tons. On the hypothesis of a uniformly varying stress the maximum intensity of vertical pressure occurs, under these conditions, at the inner toe and amounts to 8.7 tons per square foot, while the minimum pressure, at the outer toe, is 2.26 tons per square foot. As, however, the mass of masonry is not perfectly rigid nor perfectly homogeneous, these pressures at the outsides will be reduced, and that in the centre slightly increased, and thus the maximum strain on the material lessened. It may be assumed that the concrete rammed in between the large stone blocks will be the least resistive part of the structure, and to verify its strength, it has been the custom, ever since the work commenced, to mould 9 inch cubes of concrete and of mortar at frequent intervals, and to put them aside. Last November a number of these were sent to Professor Unwin to be tested, and he reported that "apparently, when most fairly tested, the blocks reach a strength of at least 187 tons per square foot in about a year after they were moulded, and there is a pretty steady increase of strength as they get older." Some of the blocks withstood the pressure of 180 tons which Professor Unwin had at command, and were sent to Messrs. Kirkaldy and Sons, where an ultimate average strength of 224.9 tons was reached.

The cement mortar gave even better results; 3-inch cubes of stone showed an ultimate resistance to crushing of 807.7 tons per square foot. In comparison with this, the maximum strain of 9 tons per square foot, which is found by calculation to be the greatest possible in the masonry, is very small. In the engraving there is shown a diagram of strains on the hypothesis that the reservoir is full, that the dam is impervious to water, and that the wind is blowing down the valley with the force of 60 pounds per square foot, and is acting on the elevated roadway which crosses the dam. The center of the resultant pressure is at a distance of 60-81 feet from O, or one-sixtieth of the width of the base from its centre, and the magnitude and direction of that resultant is represented by the line P r. The magnitude is 711 tons, and the direction is inclined 16 degrees 39 minutes from the vertical. On the assumption of a uniformly varying stress, as before, the maximum vertical pressure at X is 6.36 tons per square foot, and the minimum pressure at O is 5.22 tons. The pressure at these two points, parallel to P r, is 6.64 and 5.45 tons respectively.

If the reservoir be assumed to be empty to the level of the back water, the foundation to be pervious, and the dam impervious, there will be an upward pressure due to a head of 47 feet, or of 1.31 tons per square foot. To this extent the weight of the wall would be borne by water, and its pressure upon the rock would be reduced by the same amount. To prevent the upward pressure over the entire area even exceeding this limit, the masonry is thoroughly drained in its central portion up to a height of 47 feet, and a tunnel, 4 feet by 2 feet 6 inches, traverses the structure longitudinally to receive the water which rises from the foundation, and delivers it into conduits which emerge through the back face. For a breadth of 40 feet back from O there are no drains, and, assuming the face to be impermeable, it is possible to conceive that an upward pressure of 129 feet, or 3.6 tons per square foot, could accumulate here. Under these conditions the pressure of the masonry becomes 5.22 − 3.6 = 1.62 tons per square foot at O. A puddle wall extending the height of 57 feet above the base, and the special care spent in cementing the face of the masonry, precludes all possibility of the entrance of water from the front, while the thorough draining will prevent its accumulation. Owing to the comparatively small inclination to the vertical of the resultant of all the forces, no sliding of the wall could take place even on a smooth foundation, and upon the actual stepped rock this is even still less possible.

In conclusion, Mr. Deacon states that in his judgement the masonry dam is well suited to its purpose, and has an exceptionally high factor of stability, so high indeed that no doubt as to its abundant sufficiency can be reasonably entertained.—*Engineering.*

A New Pumping Dredge.

On the south-west coast of Long Island, bordering on Jamaica Bay, and the numerous neighboring inlets, are many thousands of acres of salt meadow, submerged about 2 feet by the highest tides. This land, as it lies, is practically valueless, but if raised above tide mark, at once becomes extremely valuable as a site for summer residences; and even now a syndicate of capitalists is contemplating the creation of a second Venice in the marsh back of Coney Island by excavating a series of canals, and from the material thus obtained raising the adjoining land.

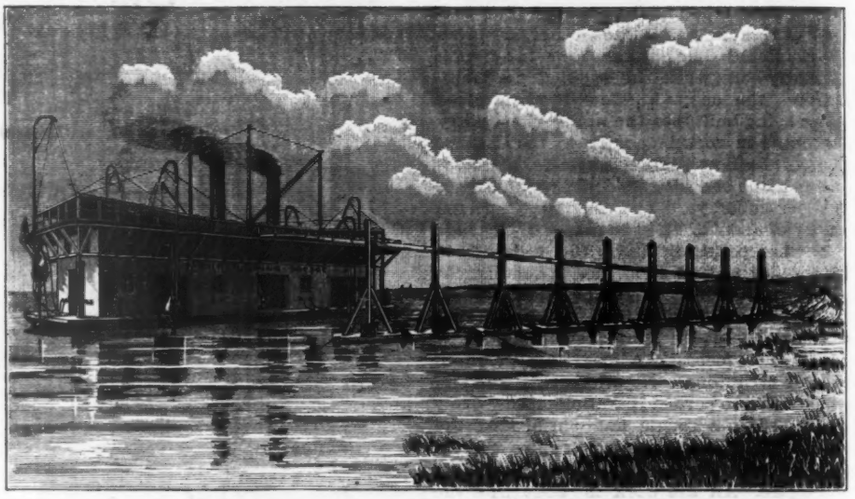


FIG. 1.

This being the condition of affairs, a recent visit to this locality proved to us that a number of contractors, with plant ranging from shovels and barrows to elaborate dredging outfits, were attempting the solution of the problem of raising the material from the water ways and conveying it on to the land thus to be enhanced in value. In this particular locality, all filling must be obtained from beneath the water surface, that being the only available source of supply; and the deepening of existing channels and the creation of new cuts are just as important as the making of new lands. Owing to the natural conformation of these inlets and the fact that they have been used as receptacles for sewage, and are being filled with all manner of refuse, their cleansing and rectification is a necessity. An important improvement suggested in this line is a broad and deep canal to be cut back of Coney Island from the lower end of Gravesend Bay to Sheepshead Bay and thence by another short cut entering Jamaica Bay and even beyond. The results would be a better water circulation, and an inside route formed for a steamer line to ply between New York and the future summer resorts to be erected upon the land formed by the deposit of the dredged material from the canals.

But to utilize the dredged matter it must be economically conveyed on to the territory adjoining the channel and that through distances ranging up to several thousand feet. Among the dredges seen on the occasion of our visit, there was one that was intended to accomplish just this character of work. This was the pumping dredge invented by Mr. G. F. Badger, of Brooklyn, N. Y. Briefly described there is first, a strongly built boat, similar in general appearance to the view shown in Fig. 1. Upon this boat is a heavy plant of steam boilers arranged in four or six sets so as to best adapt the power to the work to be performed. On top of the dredge scow, supported by a strong timber frame-work, is a hopper-like receptacle for the material lifted, and from the center of this elevated hopper a galvanized iron egg-shaped trough leads to the land to be raised anywhere within a distance of 2,000 feet. Sufficient water is pumped with the sand, etc., to convey this material to the desired point of deposit, and the filling being packed by water is permanent and without any subsequent settlement. The conveyor pipe is supported over the water upon floats and over the land by trestles.

The mud, sand, gravel, etc., is lifted from depths ranging up to 50 feet by a modification of the well-known pulsometer pump, the valves being especially designed for this work. Underneath the overhanging framework, shown in Fig. 1, is a track rail, made of two channel bars, which commands the sides and ends of the boat; and on this track, and protected by its form from the cutting effect of sand, etc., runs a four-wheeled truck. The dredging pump is suspended from this truck by chains and pulley-blocks operated by steam hoists within the boat. The pump outwardly resembles the familiar pulsometer too much to require special illustration, and the peculiar valves and fittings we are not yet permitted to make public, owing to further patents still pending.

To the bottom of this pump is attached the suction pipe, about 12 feet long (though this can be lengthened or shortened through reasonable limits), and at the end of this suction is fixed one of the important features of the pumping dredge. This is the "digger," shown in Figs. 2 and 3, which under the constant oscillation, due to the action of the suspended pump and the natural motion of the boat, tears up the bottom soil over a diameter of about 6 feet and reduces any clay lumps, turf, or conglomerated mate-

rial of almost any kind, to a size suitable for passing through the openings in the strainer in the base of the "digger." As plainly shown in Fig. 3, the teeth of the digger can be readily replaced in case of necessity, and the strainer can be opened for ease in cleaning. As a matter of fact, however, we are informed that so far in the present machine there has been no occasion to open the strainer at all.

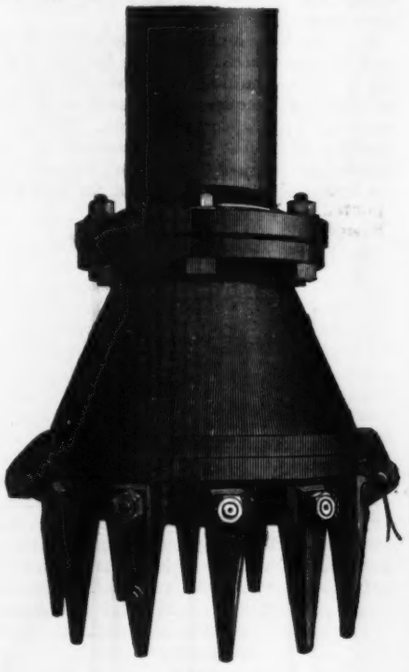


FIG. 2.

After the material passes the pump it is lifted to the hopper through an iron discharge pipe fitted with very strong gun-metal flanges, and terminating in a galvanized iron "goose-

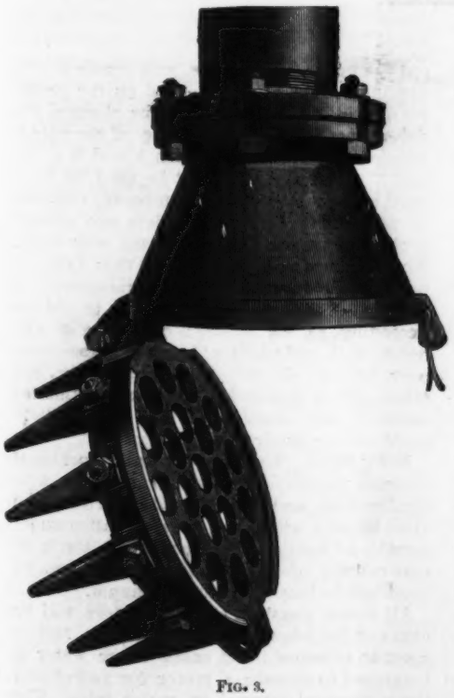


FIG. 3.

neck" as shown. The pipe is attached to a strong collar fixed upon the rolling truck. Steam is conveyed from the boilers to the pump, or pumps, through a continuous pipe running around the boat and fitted at intervals with suitable branches and valves. As the pumping may be at times necessarily suspended, with the pump and discharge column filled with sand, this material must be kept in motion, otherwise it would settle and pack so solidly that there would be much trouble in starting again. This end is accomplished by a water-pipe running around the boat and connected with a pulsometer pump in board, and with the base of the discharge column of the working pump. When the dredge-pump stops, the second pump is started and water is continuously forced into and through the material contained in the discharge column, and keeps it in motion ready for the resumption of pumping.

Though the scow upon which the present plant at Coney Island is mounted is an experimental affair hastily put together and not well adapted for fully testing the merits of the pumping device, sufficient good work has been done to warrant the inventor in claiming an average capacity of one cubic yard per minute per pump: nearly two cubic yards per minute have actually been lifted, but with the result that the hopper and conveyor trough there provided were choked and the pumping had to be stopped. The pump has handled mud, sand, gravel, clay and a species of turf orpeat; and the *average* of solids lifted is confidently put at 50 per cent. of the total volume. Mr. Badger claims that experimentally 80 per cent. of solids have been raised under very favorable conditions, and that he will guarantee 50 per cent. in mud and sand. As the number of pumps that can be worked at one time is only limited by the size of the boat and the boiler power at hand, the capacity of the dredge is simply a question of first outlay in plant.

From personal inspection of work done we can testify to its excellent character, and to the presence of very good sized pebbles conveyed far inland. We learn, too, that a plant of this description has just been made for the Pate Placer Gold Mining Co. to work on the Nechi river, in the United States of Colombia, and that arrangements are now being made to work in a similar manner some of the gold-bearing rivers of Honduras.

Municipal Engineering; Paper No. 1.*

BOSTON, MASSACHUSETTS.

(*Continued from page 52.*)

The City Engineer.

Appointment, duties and assistants.—This official is appointed annually by the mayor, subject to the approval of the Board of Aldermen, and he must be a citizen of Boston.

His duties are "to perform all services for the city as properly come under the direction of a civil engineer, and he shall be consulted on all important matters relating to public improvements of every kind where the advice of an engineer would be of service." In his annual report for 1884, this official thus classifies the rather diversified duties of his office:

A. City Engineer's Department.—Superintendence of the filling of new streets and districts; the care and maintenance of bridges; designing and superintending the construction of new bridges, retaining walls, city wharves, etc., and such miscellaneous work as may be called for by the Committees of City Councils.

B. Water Works. Superintendence of the Cochituate, Sudbury and Mystic water works, including charge of new construction.

C. Improved Sewerage. Construction of a system of intercepting and outlet sewers.

D. Parks. Charge of the Engineering work in connection with the Back Bay and other proposed parks.

He is officially allowed for the discharge of the duties of his department the following subordinates:

One Assistant City Engineer,
Three Assistant Engineers,
One Clerk, One Bookkeeper,
Three Draughtsmen,
Eleven Transitmen, Levellers, Rodmen and Axemen.

For the time being, however, he has three other assistant engineers engaged upon what might be called special work, *i. e.*, improved sewerage, parks and water works construction.

The City Engineer must report annually in January to the City Council, all that relates to his department; such as the number of persons employed, detailed expenses, nature of work performed, condition of all structures under his supervision, etc.

Plans, Scales, etc. In the office of the City Engineer there are over 6,000 loose plans and 14 volumes of bound plans, together with a reference library of 462 volumes. In connection with the water supply, the standard scale adopted is as follows: Pipe plans, 1-inch to 100 feet; general plans, 1-inch to 500 feet. These plans are stored in rack-cases and cases of drawers, one of the latter type being shown in Plate 2*.

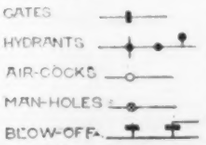


Plate 3. Symbols on Pipe Plans.

On all the pipe plans of this department a convenient system has been in use, since 1870, of indicating the dimensions of pipes by certain colors, varying the width of the lines drawn to represent pipes from $\frac{1}{32}$-inch for the largest, to a fine but distinct line for the smaller diameters. The following is the color schedule for Water Pipes:

40 inch diameter	Prussian Blue
36 " "	Payne's Gray
30 " "	Warm Sepia
24 " "	Burnt Sienna
20 " "	Gamboge
16 " "	Indian Red
12 " "	Emerald Green
10 " "	Carmine
8 " "	Pale India Ink
6 " "	Cobalt Blue
4 " "	Vermillion

The method of indicating on the plans, gates, hydrants, etc., is shown in Plate 3.

The Water Board.

Appointment, Duties, etc. As the construction and maintenance of the water works of Boston constitute an important part of the duties of the City Engineer we shall follow with the consideration of this board.

The Boston Water Board consists of three members, one of whom is appointed annually by the mayor, subject to confirmation, and shall hold office for *three* years from the first Monday in May of the year of his appointment. As pay, each member is allowed the sum of $5 for each half day in actual service as a member of the board.

This board has entire charge of the water department of Boston. It may, subject to the approval of the mayor, lease or sell any property connected with the water works; make contracts or purchase supplies of all kinds needed for this department; provided, however, that all contracts, excepting a contract for laying pipe, exceeding in their estimated amount $10,000, must first be advertised five times in each of three newspapers published in the city, and the last publication shall be at least one week before the time fixed for opening the bids. They have supervision over the

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* This case is arranged with drawers below, one tier being removed as shown, and at the ends has shelves for the reception of rolled maps. The two ends are closed by a sliding shutter made like the covering of a "roller-top" desk.

pay rolls of clerks, inspectors and laborers in the department, and must report to councils annually in January, on the general condition of the works and all their acts.

Under the head of proposals for materials or supplies required for the water department, plans and specifications of the work to be done and schedules of the materials, etc., must be put on file in such office as the board may designate, and be opened to public inspection at the time specified in the advertisement. Each proposal must conform to these specifications and requirements, must be enclosed in a sealed envelope directed to the board and accompanied by a bond to the city, with sufficient sureties in a sum not less than $500, as may be specified in the advertisement; this bond to be void if the accepted party shall in a specified time make and deliver a contract for the performance of the subject matter of his proposal, and at the same time give a further bond with sureties for the performance of such contract. Money or other collateral may be deposited, however, instead of the above bonds. All proposals must be publicly opened at the time and place mentioned in the advertisement; but the board may reject any or all bids, and "it is their duty" to reject the bids of irresponsible parties.

The Water Registrar.

This officer is appointed annually by the mayor, and he shall, under the control and direction of the Boston Water Board, assess all the water rates of both the Cochituate and Mystic works, according to such tariff as may be established by the said board.

The registrar must as often as once a year cause the premises of every water-taker to be visited by skilled inspectors; under the control of the board and in proper cases he may make and record abatements in water-rates; he must exercise a constant supervision over the use of water, and enforce all regulations relative thereto.

On or before January 1st., of each year, he must make out all bills for the use of water, and send them to the city collector for collection. When two or more dwelling houses, or other estates are valued together for the assessment of taxes, the water registrar must make separate valuations of such houses, and when a portion only of an estate is justly chargeable for a water-rate, he shall make a proper valuation of such portion; and the water-rates to such premises, when based on valuations, must be made on these valued by the water registrar.

He must keep suitable books in which he shall have entered the names of the water-takers, the kind of building, name of street and number, the nature of the use, number of taps and the amount charged. These books must always be open to the inspection of the water board, mayor and councils, and, when not actually in use, to public inspection. The water registrar reports annually on or before May 15th, and he receives all applications for the turning on or off water, and for all service and other pipes to convey water to the premises of the consumer.

Water-Rates.

Dwelling Houses.—The rates in Boston for dwelling houses are based upon their valuation, as follows:—Every dwelling house, including the land under and used in connection with it, shall be charged, when it is valued for the assessment of taxes at $1,000 or any less sum, and occupied by one family only, *six dollars* annually; and for every additional $1,000 or fractional part thereof, *one dollar*, until the valuation for taxes shall amount to $25,000; and for every family more than one in a dwelling house, the charge shall be for each, *two* dollars.

In addition to the above rates, *five dollars* is charged to each dwelling house for the use of a bath-tub and a self-closing water-closet; for all other styles of closets, *ten dollars* are charged.

Family Hotels.—In houses rented in suites of rooms to different families, the rates are based upon the rental of such tenement, viz.: Every tenement having a faucet within it shall be charged *three dollars* annually, and *fifty cents* additional on every one hundred dollars, or fraction thereof, rent above $300; *provided*, that the said rate may be based upon the estimated yearly rentable value of each such tenement. In addition to these rates, each bath-tub and self-closing water-closet is charged *three dollars;* all other styles of closets, *ten dollars.*

In tenements where occupants take water from a tap in common with other tenants of the house, having no taps in their own, each tenement is charged *two dollars* annually. An additional charge of *two dollars* is made to each tenement, the occupants of which use a water-closet in common with other tenants.

These family hotels are meant to include dwellings, especially constructed for and occupied by three or more families, with each tenement arranged in flats and having the conveniences of a distinct house, without regard to location of water fixtures. All other dwellings occupied by one or more families are classed and assessed for the use of water upon their respective valuations.

Miscellaneous Rates. The detail of all the various water-rates charged in the city of Boston is too voluminous for insertion here, so we shall confine ourselves to such as we consider worthy of special mention. *Hotels* and *boardinghouses* (the latter assessed at over $15,000) are charged *three dollars* for each bed, not including water for bath or for uses without the house. *Hand-hose*, with nozzle not exceeding $\frac{3}{16}$-inch diameter, used on the premises of water taker only will be charged *five dollars* for the season. The use of the hose is restricted to one hour between 5 and 8 A. M., and 5 and 8 P. M.; it must be used by hand only, and not adjusted on temporary supports of any kind. Lawn sprinklers are strictly prohibited unless a meter is used with them. *Steam-engines* working not more than 12 hours per day are charged by the horse-power, as follows: For each horse-power up to and not exceeding 10, *ten dollars*; exceeding 10 and not over 15, *eight dollars*; for each horse-power over fifteen, *six dollars*. *Manufactories*, and other parties supplied with water by estimated quantity, are charged at the rate of *three cents per one hundred gallons.*

Meter Rates. The rate for water furnished through meters is *two cents per each one hundred gallons*, and is collected quarterly and must be paid within ten days therafter under penalty of having the water cut off. But in no case can the *minimum* charge for any metered premises be less than $10 per annum.

All water passing through meters will be charged for, whether used or wasted. Meters must be attached in all cases where water is furnished to operate a motor for power, and the water used charged at meter rates. The Water Board reserves to itself the right to attach recording meters to the premises of any water taker at any time, and to the consumption by meter shows an excess over the quantity represented by the amount paid for by

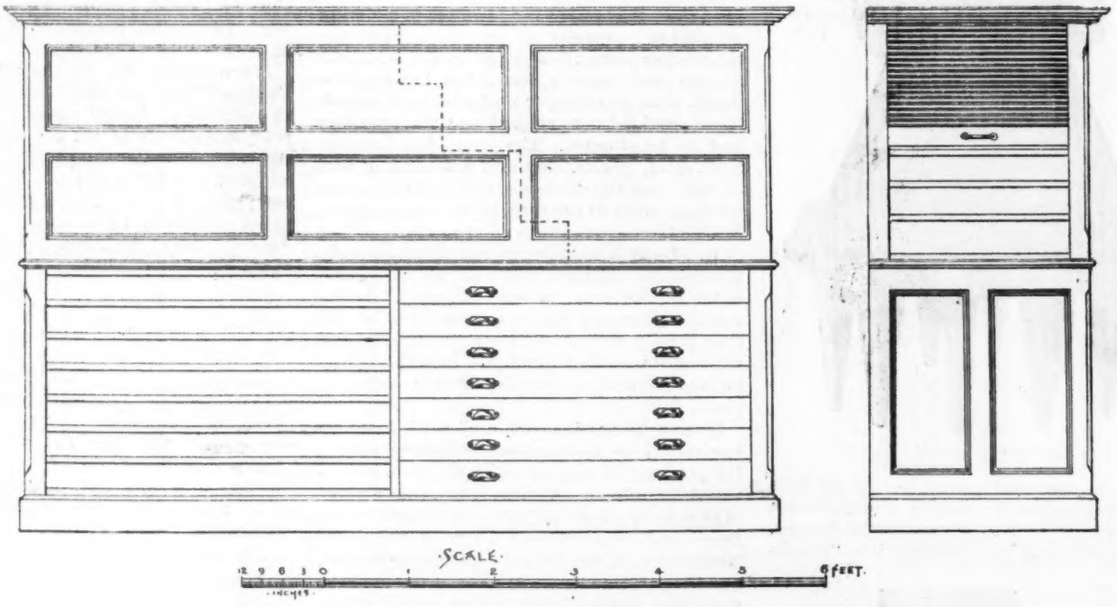

Plate 2. Map Case in City Engineer's Office.

schedule rates, such excess will be charged by meter rates. Each dollar paid by schedule rates represents 5,000 gallons.

Penalties and Regulations. In all cases of non-payment of the water rent for sixty days after the same is due, the water registrar shall serve a summons at the premises of such delinquent; and unless said rent is paid within three days thereafter, together with 25 cents for said summons, the water registrar shall cut off the supply; and the water shall not be let on, until the amount due, together with the 25 cents for the said summons, and $2 for the shutting off and letting on, is paid; *provided*, that no occupant shall be required to pay the amount due from a former occupant; and *provided, also*, that in cases of specific supplies, or for fractional parts of the year, when the water has been let on, the summons may be served, and the water cut off immediately; and it shall not be let on again except upon the condition before mentioned. The foregoing provisions shall apply when two or more parties take water through the same service-pipes, although one or more may have paid the proportion due from him or them. In shutting off water for any purpose at the request of a water-taker, a charge of $1.50 is made for turning it on again.

No application for the extension of water pipes from mains already laid will be granted unless the street is properly graded, and unless the prospective income will be equal to 6 per cent. on the cost of laying a 6 inch pipe.

All water-takers must keep the service-pipe within their premises and under the sidewalk in good repair and protected from frost, and they are liable for any damages resulting from any neglect in this direction.

(TO BE CONTINUED.)

Engineering in War Times.

Written for ENGINEERING NEWS.

BY S. H. LOCKETT.

Formerly Col. of Engineers, C. S. A. and Chief Eng., of the Dep't. of Alabama, Mississippi and E. Louisiana.

Perhaps nothing strikes the young engineer so forcibly, in his early professional life, as the insufficiency of the knowledge obtained from his books and tutors. When first thrown upon his own resources, and naturally feeling somewhat doubtful of his theory and knowing his own lack of experience, he turns at once to his well conned text-books expecting that they will help him out of his difficulties. To his surprise and his disgust he discovers that none of them seem ever to have contemplated the particular conditions by which he finds himself surrounded; the emergencies confronting him appear altogether new and peculiar. If he is "cut out" for an engineer, he throws away his text-books, brings his hard common sense to bear upon existing conditions and very generally succeeds. If he doesn't, he simply fails ignominiously.

The experience of the writer during the late Civil War, as an engineer officer of the Confederate Army, afforded many illustrations of the truth of the above proposition. He had graduated at West Point as an engineer, had spent one year as instructor at the Academy and nearly another year in superintending the construction of Fort Clinch, near Fernandina, Florida, when the Southern States seceded. His resignation was tendered and accepted by the President of the United States, and he reported for duty to the Governor of Alabama.

The writer was first ordered to Pensacola Navy yard. That important depot of naval supplies had been captured by State troops of Florida, Alabama and Mississippi, though Fort Pickens was still held by Federal troops. The first work for the engineer was to construct batteries to bombard Fort Pickens. The navy yard contained an ample store of guns, gun-carriages and ammunition, but they were all for naval service, and the narrator had never seen a ship's gun mounted or manœuvred in all his life, and nothing in "Mahan's Field, or Permanent Fortifications" gave him the least light upon the subject of setting up naval guns in sand-bag batteries. Fortunately for the reputation of the engineer-in-charge, there was still about the navy yard an old ship's carpenter, Tom Fell by name, and with his aid as mentor and guide, all difficulties were overcome.

Confederate Bridge at Demopolis, Alabama.

We soon had a number of the guns in position, all rigged with the necessary blocks and tackles, breeching etc.; but the next question was to work them with the wild, undisciplined and undrilled mob, which constituted the so-called Army of Occupation of Pensacola, and the old U. S. Forts Barrancas and McRae. None of them knew the cascabel from the muzzle of a gun, nor a hand-spike from a marling-spike; nor, in fact did the writer know one command in the drill of a ship's "great guns." Under these circumstances the expedient was adopted of labeling, with any name deemed most appropriate, the various parts of the gun, its carriage and the tackle, and the commands were given accordingly. This was not an original idea; it had already been practiced by Col. Henry Maury, at one time a Cuban filibuster. Col. Maury had been an officer of the U. S. Marines, and was a first-class sailor himself; but the restless spirits who joined him on one of his expeditions were all land-lubbers, and when he attempted to drill them in seamanship on his vessels in the harbor of Mobile, he had some trouble. None of them knew one end of the ship from the other, or the main-truck from the jib-boom, but they could all play draw-poker and thoroughly understood the "keerds;" so Col. Maury took their cards and tied them to the spars and ropes of his vessel, and drilled his men somewhat as follows:—"Haul away on the Jack-of-diamonds;" "Ease off on the Ace-of-spades;" "Climb up to the Queen-of-hearts, you infernal land-lubbers," etc. The scheme worked well, and by somewhat similar expedients the ship's-guns were manœuvred in the sand-bag batteries of Pensacola.

These were what the Confederate soldiers afterwards called the "honey-moon days" of the war; and many were the ludicrous bits of experience the writer has had with the untamed militia of the Gulf States in the prosecution of his engineering work. For example, on one day giving instructions to a soldier who was working on a battery, he was startled by the reply of, "see here Mister, if you think you can do this job better than I can, take this shovel and go to work, I'm d—— willing to quit." At another time when moving a heavy gun through deep sand with a lumberman's log-carriage, he had selected two of the stoutest men from the ranks of the working party to act as wheel-horses on either side of the tongue; this proceeding seemed to amuse the rest of the party immensely, and on inquiring the reason for all this hilarity, it was discovered that one of the wheel-horses was ex-Senator John Cochran, and the other was U. S. ex-Congressman James L. Pugh, who had thus been selected, not for the post of honor, but the one of hardest labor.

At yet another time, Gen. Bragg referred to the writer a gentleman who claimed to be a distinguished French engineer, and who had a scheme for the certain and easy capture of Fort Pickens. His plan, expressed as nearly as possible in his own words, was about this: "You get, Sare, one gran Miesseeseepee steamboat; you put on her one tousand brave men; you give them hook and ladder and sabres; you go easy, one dark night, across Santa Rosa Sound; you land under the walls of Fort Peekan; you throw up your ladder; you make one grand roosh and you take Fort Peekan so easy as dat," with an expressive snap of the fingers. When it was suggested that Fort Pickens was heavily armed with Columbiads; had a trained and alert garrison which would be sure to note the approach of the boat, and would in all probability open fire and sink her in a few minutes, our Frenchman disposed of that contingency by remarking: "Ah, Sare, ze steamboat captain must look out for hees own steamboat." But these stories are hardly suitable for the columns of a technical journal and we will turn to more serious matters.

The Confederacy was sadly in want of means, material and implements for engineering work during the entire war. Our armies were never properly supplied with bridging outfits, such as pontoons and adjustable trestles; nor were they equipped with ready-made railroad bridges and *tunnels*, such as General Sherman's army was reported to carry in the famous "March through Georgia." Our engineers had very frequently to make their wits take the place of more substantial material. As illustrations we give one or two expedients adopted by the writer for crossing armies over rivers.

During the campaign of the fall of 1862, General Grant pushed Pemberton's army back from Holly Springs, Miss., to Grenada. At this latter point is the Yallabusha river with a wide bottom on the north side and bluff banks on the south. When the river was reached it was swollen and too deep to ford, and the writer was ordered to build a bridge in one day sufficient to cross an army of 20,000

men with all its artillery, quartermaster, commissary and ordnance trains. A brief examination of the site convinced him that it was hopeless to undertake to build a trestle bridge in the time specified. But there was already a Howe-truss railroad bridge across the stream, and he at once commenced to "figure" upon the best method of utilizing it; the difficulty here lay in the long and high trestle approach across the bottom on the north side, and the impossibility of getting sufficient planking to make a roadway for wagons. It was then discovered there were in and around Grenada several thousand bales of cotton, which were gathered as rapidly as possible and brought to the bridge. These bales were then piled up against the nothern abutment of the bridge and a ramp or slope thus constructed, which gave us an approach by steps made as gradual as the number of bales would permit. Brush was next thrown upon the bales and this was covered by earth, and fence-rails were used to make a corduroy road, which was speedily utilized by the retreating army.

After the siege and fall of Vicksburg, the paroled army under Pemberton marched across the State of Mississippi. The first serious obstacle encountered on this sad march was at Pearl River, which we struck at Bryan Station, south of Jackson. Here we found a deep, dark river, about 300 feet wide, in our path, and we had none of the paraphernalia of an army, save about one wagon to a regiment which transported our scanty rations, But beyond the river was Dixie's land and our homes, and to cross the river and to cross it quickly, was the burning desire of every man there.

On inquiry, the writer found that an old ferry-flat had been scuttled and sunk in the immediate neighborhood, and after considerable diving, it was finally found and raised. The holes in this boat were stopped by nailing planks over them and pieces of blanket were used for calking; this furnished the means for ferrying over our wagons, but the men had yet to be provided for. So, while the boat was being mended the troops had been set to work tearing down some negro cabins and a gin-house near by, and in the gin-house we fortunately found an entire coil of cotton-baling rope. With the flat-boat ready for service, one end of this rope was transferred to the further bank and, there secured to a tree, it was hauled taut, and fastened on the near bank; meanwhile the men had been making rude rafts of the logs, tying them with anything at hand, and these rafts were now tied, end on, to the hawser; planks from the cabin floors were next laid from raft to raft and a flimsy but practicable bridge was secured, over which the officers and men walked dry-shod, but in Indian file.

The next experience of the writer in impromptu bridge building was in the summer of 1864. General Sherman at that time made his first effort at boring holes into the vitals of the Confederacy. He had driven General Polk's army from Jackson, Miss., to Meridian, and we had lost our pontoon boats at Pearl River. The engineer troops, under the author's command, were ordered to push on rapidly to the Tombigbee river and to prepare a crossing for the army. Steamboats and barges had been ordered by telegraph from Mobile, to Lewis Ferry, south of Demopolis, so we had been informed; but on arriving at the ferry after a forced march of a night and a day, we found a lone ferry-flat. Expecting the steamers would soon appear, we commenced gathering all the lumber we could get by pulling down the negro cabins, barns and outhouses on the Lewis plantation. But no boats came, until after hours of feverish waiting, we heard the welcome puff of a steamer coming down the river; but this boat showed no disposition to land, and on being hailed the captain informed us that he had commissary stores aboard in charge of Major Somebody and could not stop. He did stop, however, under the persuasive muzzles of rifles of the engineer troops, and on having the situation explained to him, both the major and the steamboat captain gave us their hearty co-operation.

With this steamboat we scoured the river up and down for a dozen miles or more and gathered all the wood-barges, ferry-flats and small boats that we could find. By night-fall quite a flotilla was secured and on the site of the bridge which was to be about 420 feet long. With an excellent new hawser that was luckily on the steamer, the river was again spanned as at Pearl river; then began the lashing of the boats of all descriptions to the hawser, and as these did not quite hold out the steamboat was made to take its place in the line. The next day, before the bridge was quite finished, General Polk's army arrived, with General Sherman supposed to be in hot pursuit. The soldiers soon fixed the planks needed to complete the job; and before dark the whole army of 15,000 to 18,000 men, horse, foot and artillery, together with an immense train of wagons moving stores from Meridian were on the trans-Sherman side of the Tombigbee.

A few days later, after reinforcements had reached General Polk, we put the same sort of a bridge across the river at Demopolis, to cross over the army that proposed to pursue General Sherman. The sketch shown above is from a pen-drawing of this latter bridge made at the time.

Ventilation of Sewers.*

In presenting a paper on the ventilation of sewers for the consideration and discussion of the society, the author has confined himself to giving a short account of what has been done, and a description of a system which he has personally adopted as the result of investigation into the working and defects of previous systems.

Until the last twenty or thirty years it was not the general custom to ventilate sewers, and most of the main sewers themselves were constructed without manholes or ventilators, the branch sewers often discharging into cesspools, the overflow from which was connected with the main sewers—the cesspools being as far as practicable hermetically sealed and seldom emptied, the consequence being that the stagnant sewage was decomposed and the germs of disease rapidly spread.

The numerous cases of typhoid and kindred diseases arising from these defects in works of drainage caused sanitary reformers to awake to the dangers of pent up sewage, and it was then sought to send the sewage away as far and as quickly as possible, and outlets were provided for the escape of the sewer gas both for cesspools and sewers.

The modern French system has been based somewhat on this system, the cesspools themselves being retained, but made as air and water tight as possible, with upcast shafts to take the sewer gas from the cesspools, and the soil-pipe carried down from the top of the house, with an outlet to the air at the top, and the bottom extended below the surface level of the liquid retained in the cesspool as a trap. This system, called the *fosse fixe*, is sometimes connected with a sewer, sometimes not, and, of course, especially in the latter case, involves periodical and frequent cleansing, and this necessity has caused the invention of several ingenious arrangements for emptying the *fosse fixe* or cesspool; but this system is much more costly than the English, owing to the large annual cost both of cleansing the cesspools and carting away the soil; otherwise the effect where the work is scientifically and well executed, and the emptying and cleansing constantly attended to, is to keep the sewer gas from being discharged within the dwelling. But much more sewer gas is generated than in the English system of constant flow, and the annual cost is about five times the cost of removal by water, or about 12s. 6d., as compared with 2s. 6d. per head per anuum in the case of large towns.

The main sewers in France and generally abroad are, as a rule, very badly ventilated, and their construction is often such as to favor the generation of large quantities of sewer gas, discharged often by gullies and other openings immediately under the nose of foot passengers.

In England the sewers as far as their liability to generate sewer gas is concerned have been generally much better constructed than abroad, and of much smaller dimensions than the French, and better proportioned to the normal flow of sewage, filling consequently at all times a larger portion of the sewer, and the sewage runs with a greater and for the sewers more self-cleansing velocity. Sewers so constructed also expose a smaller proportionate surface of sewer wall to the alternate wetting by sewage and drying and decomposition which takes place, especially at certain seasons of the year, and when dry weather follows after a storm. The English sewers are better constructed to avoid generation of sewer gas, and better cleansed, but until recently very little has been done in the way of ventilating the sewers except by the insertion of a greater or less number of stink outlets, and next to nothing has been done to render sewer gas escaping at these blow-holes innocuous, nor until recently has much been done to assist in the cleansing of sewers in a practical manner. It is needless to inform engineers that it is absolutely necessary to keep sewers clean, either by natural or artificial flushing, and for this purpose where a sewer is laid with a flat gradient much more is needed that an occasional flush at a few points from a 500 or 1,000 gallons self-acting flush-tank, the flush from which, in a sewer of moderate size, is spent in a very short distance. Most sewerage engineers who have turned their attention to the ventilation of sewers have contented themselves with making the stink outlets or ventilating manholes at intervals of about sixty yards and upwards, the distance generally adopted being over 100 yards, the idea being that the sewer gas discharging at these outlets would be sufficiently diluted with atmospheric air to render it innocuous. The author's own practice has been of late to place ventilating manholes 200 feet apart as a convenient distance for examination, and quite far enough for the free circulation of air which the author seeks to secure in every sewer.

As the age of sewers has increased, all the defects due to defective private house drainage and connections of house drains with the sewers have become apparent, and the smells from some ventilating manholes have so increased, that public opinion has been roused even to the extent of compelling the stoppage of ventilators, instead of adding to their number; the public generally, in a time of excitement and fear of microbes and bacilli, acting upon the principle that what the eye does not see or the nose smell the heart does not grieve at.

* A paper read at a meeting of the Civil and Mechanical Engineers Society by Mr. George Eedes Eachus, M. I. C. E.

When ventilators were first introduced, many attempts were made to filter the sewer gas before allowing it to discharge into the open air, and many and complicated were the ventilators patented, charcoal being generally the substance employed to filter the gas; but owing partly to the charcoal being often so displaced, when the filter was put in, that the sewer gas could pass freely through the open spaces; partly owing to the ventilators being so constructed that the charcoal was constantly wet and clogged, so as not to act properly; owing to these and other causes, these charcoal trays and filters have gradually come into disuse.

Various attempts have also been made to create strong upcast draught by furnace chimneys, cowls, or other artificial means; but these attempts have never been more than locally, and then only very partially, successful.

The author having himself encountered most of these practical difficulties, tried a number of experiments at his own house and on sewers under his charge, in order to test by the practical and elementary sense of smell (which is the test put by the public), rather than by delicate anemometers and other means, when and under what conditions the sewer gas was most freely generated and discharged. The next point was to ascertain how the flow of sewer gas could be so regulated as to prevent undue accumulation at any one point, and how the passers by the ventilators could be relieved of the constantly unpleasant smell experienced at many places. The result of these experiments was to show that a well-constructed sewer with a moderately quick fall and constant flow, running from one-third to one-half full or more of sewage, generated the least quantity of sewer gas; also that a sewer similarly constructed with a similar fall seemed to form the best chance for the conveyance of sewer gas; and for this reason, where practicable, the author of this paper prefers to have a sloping outlet, up which the sewer gas may ascend, so as to arrive at its point of discharge with the least possible obstruction. More sewer gas was found to be generated in the larger and badly constructed sewers, espeyciall in those with flat fall and varying flow, and where the velocity of flow is insufficient for the sewer to be self-cleansed. The sense of smell is, of course, most apparent when the necessary conditions of stagnation and comparative temperatures of the sewer and of the air happen to meet, and hot fluids entering the sewers always add to the aroma and increase the difficulty of dealing with the gas.

The flow of the gas and the sense of smell both seem to travel, as a rule, in the direction inverse to the flow of sewage, but this rule is by no means without exceptions. For the purposes of this paper it is, however, better to deal with the general rule, which is, that sewer gas when generated travels upward, and tends to accumulate in the upper districts at points where there is some check to the flow, or some local circumstance to make a ventilating manhole a good upcast shaft. The author had a good case in point where a clean, new, well laid sewer, with a rather quick fall and no sewage in it, served as an admirable ventilating shaft for an old sewer.

To prevent this accumulation of sewer gas—to dilute the gas with atmospheric air, and to filter the diluted gas before its discharge—the author, in conjunction with Mr. Maignen (the well-known patentee of the *Filtre rapide*), has taken out a patent for localizing the sewer gas, diluting it as much as possible, and filtering it through a charcoal filter in such a way as to overcome the disadvantages above referred to. The accumulation is prevented by localisation, and this is effected by means of double or divided manholes provided with stops or valves, placed at the lower part of the middle division in each manhole. The model and drawing show the general arrangement by which the air is allowed to enter the sewer through that part of the manhole called the air inlet. The air passes up the line of sewer mixing with the sewer gas as it travels until it comes to the valve or stop at the next manhole, which prevents its further progress, and turns it through the filter out at the ventilating cover or gas outlet. This valve or stop is made in sections, being like a balance-valve on a common spindle, and each of the lower sections working independently of those above, so that while the sewage flows down the sewer, the flow of gas in the opposite direction is arrested and diverted up the gas outlet at each manhole.

In trying to ascertain the velocity and force with which sewer gas travels, the author has not yet met with great success; but he finds that, except with large differences of temperature or sudden variation in flow, the current is hardly perceptible, and yet without any perceptible current of gas there may be very strong smells perceptible at many ventilators. These would appear to be due to the diffusion of the gases which always takes place, rather than to an actual current; and this will be readily understood by reminding the members of the experiment which shows that if a heavy gas is placed in the lower half of a closed vessel, and a light gas in the upper part, the two parts divided by plaster of Paris, the gases are found to diffuse, even passing through a considerable thickness of plaster of Paris to mix one with the other.

In carrying out this system the author prefers, where practicable, instead of having the outlet of the upcast shaft at the surface of the road, to conduct a pipe by easy lines up the side of a house or other convenient place. Where this can be done it is not essential in many instances to filter the sewer gas, but where it cannot be done the author has found, after nearly twelve months' experience, that the filter of the form shown by the model effectively does away with any objectionable smell from the sewer gas, the charcoal cannot be displaced to allow the free passage of the gas, and both the form of the filter and the overflow for the water provided in the dirt box prevent the charcoal becoming wet or damp, even after many months use. The vapor arising from the sewage is condensed on the underside of the filter without wetting the charcoal.

A very similar arrangement to the above described has been used by the author in the drainage of the Town Hall, Edmonton, and there is no difficulty in the general application of the system for house drainage as well as sewerage.

The author is an advocate for trapless valve closets and drains without syphons, and for the straightest possible lines of soil-pipes and ventilating pipes, so as to maintain a free circulation from each air inlet to the adjoining gas outlet, and the air ought, in the author's opinion, to have a free circulation through every foot of sewer drain and soil-pipe. The variation between the day and night flow in this system secures fresh supplies of atmospheric air in each length of each sewer every night. The system can in most cases be easily adapted to existing arrangements of sewerage and house drainage.

It has now been in work adjoining the Town Hall, Edmonton, for twelve months, and for nearly nine months in another street at Edmonton; and Mr. Laws, the engineer, of Newcastle, who saw the model at the Exhibition this year, where it was awarded a medal, has been twice to Edmonton to inspect its working, and intends trying it in certain places in Newcastle which have hitherto given trouble.

The author finds that the bottom sections of the valve are not required, and indeed the system seems to work best without them. It is not even necessary to stop the back flow of sewer gas that the valve should reach the sewage at its normal level, although the author prefers that it should nearly, if not quite, touch it.

THE HISTORY AND STATISTICS OF AMERICAN WATER WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.; M. INST. C. E.

795.—CLEARFIELD, PA.

Clearfield, Clearfield county, Pennsylvania, in lat. 41° N., long. 78° 25' W., is on the West branch of the Susquehanna river. Settled in 1820, it was incorporated a borough in 1830.

Water works were built by a private company in 1882, taking the supply from a mountain stream. A dam 4 feet high and 35 feet long, at a point 3 miles from the town and 190 feet above its level, diverts the water into a 10-inch cast-iron pipe. The flow in the stream in the dryest season is largely in excess of the capacity of the pipe.

Distribution in the borough is by 6¼ miles of cast-iron pipe of 10 to 3 inches diameter, with 36 fire hydrants, 24 gates and 230 taps The town pays $700 per year for hydrant service. Service pipes are of wrought-iron. The capital stock of the company is $40,000. The works have cost $40,300. There is no debt. The annual cost of maintenance in 1884 was $480, and the revenue from all sources $3,483.

The population in 1880 was 1,809. E. A. Bigles is Secretary and Treasurer.

796.—CHESTERTOWN, MARYLAND.

Chestertown, Kent county, Maryland, in lat. 39° 15 N., long. 76° 10' W., is on level grouud on the Chester river, 14 miles from its confluence with the Chesapeake. It was settled over 100 years ago, and Washington College, situated there, was incorporated in 1782. Water works were built in 1885 by a private company, after plans of W. W. Taylor, taking the supply from springs, the water from which is collected in a basin and then pumped by steam into a reservoir holding 100,000 gallons, constructed in earth excavation 75 feet above the town.

Distribution is by 4 miles of wrought-iron pipe of 6 to 3 inches diameter, with 29 fire-hydrants and 100 taps. The town pays $550 per year for hydrant service. Service pipes are of galvanized iron. The capital stock of the company is $15,000, and the bonded debt $15,000 at 6 per cent.

The population in 1880 was 2,359.

Charles T. Westcott is President of the company, M. W. Thomas, the Secretary, and W. W. Taylor, Superintendent.

European Railway Progress.—Some statistics of considerable interest have just been collected in illustration of the progress of railway construction in Europe in 1884. It appears that at the close of 1884 there were 118,334¼ miles of railways in operation upon the European continent, as compared with 114,374⅝ miles at the close of 1883. It follows that 3,959¾ miles of new line were opened in Europe last year. The increase, it will be seen, is equivalent to nearly 3½ per cent. upon the 114,374⅝ miles of line at work in December, 1883. The 3,959¾ miles representing the new line brought into operation in 1884 was made up as follows: Germany, 518¼ miles; Austria and Hungary, 780⅝ miles; Belgium, 28⅝ miles; Denmark, 81⅞ miles; Spain, 257½ miles; France, 938¾ miles; Great Britain and Ireland, 209 ⅜ miles; Greece, 95⅝; Italy, 293¾ miles; the Low Countries and the Luxembourg, 83⅛ miles; Portugal, 20⅝ miles; Roumania, 51⅞ miles; Russia and Finland, 326⅞ miles; Servia, 152½ miles; Sweden and Norway, 136¾ miles; and Switzerland, 6¾ miles. The extent of line in operation in Germany at the close of 1884, was 22,900⅝ miles. France ranked second with 19,510 miles; Great Britain and Ireland, third, with 19,071¾ miles; Russia and Finland, fourth, with 15,865⅝ miles; and Austria and Hungary, fifth, with 13,615¼ miles.—*Engineering.*

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

TRIBUNE BUILDING, - NEW YORK CITY.

THE ENGINEERING NEWS PUBLISHING CO. PROPRIETOR.

VOL. XV. Saturday, January 30, 1886.

CONDUCTED BY

GEO. H. FROST, - - - Assoc. Am. Soc. C. E.
D. McN. STAUFFER M.Am.Soc.C.E.: M.Inst.C.E.

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THE subject of the paper for the meeting of the American Society of Civil Engineers on Wednesday next is "The Water Works of Southington, Connecticut;" by Theodore H. McKenzie, M. Am. Soc. C. E.

THE Iowa Society of Civil Engineers was organized at Cedar Rapids, Iowa, Jan. 15, 1886.

The following officers were elected: President, C. W. Irish, of Iowa City; Vice-President, F. H. Macdonald, Cedar Rapids; Treasurer, A. W. Swanitz, Cedar Rapids; Secretary, H. F. White, Cedar Rapids.

The next meeting will be held at Cedar Rapids, March 17th, 1886.

The Trial of the Dolphin.

This craft, on which so much has been written and on whose supposed structural weakness "such high hopes of orders at *a long price*" were indulged by our contemporaries on the other side, has at length sailed out to find a storm. Just below Cape Hatteras she found something coming at the rate of 60 miles an hour which she faced, "maintaining a rate of fourteen knots per hour during the heaviest part of the day's weather." After the engines were slowed down to 9½ knots "she rode the storm like a duck in a mill pond." The "experts" are said to have all been seasick and they hied themselves home "to report." As no mention of the necessity for any repairs to the "Dolphin" is made, we can judge just how seasick they were by reading their report.

Black Sea and Baltic Canal.

The Russian Ministry of Ways and Communications has applied for a preliminary credit for the survey and initiatory operations of a junction between the waters of the Black Sea and the Baltic. The project is declared by experts, surveyors, and engineers to be entirely feasible. The survey will probably commence in the spring.

Channel Tunnel.

The friends of this project are again moving, having deposited a bill for a tentative continuance in the Private Bill Office. But the British fears of a subaqueous invasion are not yet quieted it seems, as the Board of Trade have intimated to the promoters that it will be their duty to oppose it in Parliament.

Manchester Ship Canal.

The Salford Town Council at a special meeting, by forty-three to eleven passed a resolution empowering the corporation to promote a bill in Parliament to enable them to subscribe £250,000 to the capital stock of the Manchester Ship Canal Company.

This is very much like town building in the west.

Estimate of the Italian Minister of Public Works for the Fiscal Year 1885-86.

The *Gazetta Officiale* states that the sum of $59,109,147 has been appropriated to the Department of Public Works for the fiscal year from July 1, 1885, to June 30, 1886. The itemized appropriation is as follows:

	Appropriation. Ordinary.	Extraordinary.	Total.
General expenses	$ 247,203	$ 575,400	$ 822,603
Salaries of the officers and personal expenses	1,138,756	—	1,138,756
Roads	1,698,173	3,256,710	4,954,883
Rivers	1,615,914	2,618,490	4,234,404
Works used in rivers and roads	—	140,000	140,000
Drainage and irrigation works	24,600	1,031,540	1,056,140
Harbor and lighthouses	991,859	3,338,700	4,330,559
Railroads	87 053	162.000	249,053
Telegraph lines	2,064,640	63,467	2 127,107
Postal service	6,787,993	—	6 787,993
New railroads	—	33,180,600	33 180.600
Other expenses	87 049	—	87.049
	14,742,240	44,366,907	59,109.147

The railroads belonging to the Government are leased to private companies for the purpose of operation since July 1, 1885.

Safety Cartridges.

The use of water tamping, both as a preventive of danger in firing mines and as an aid to the explosive effect of the charge was referred to at some length in our numbers for January 31st and May 9th, 1885. An improvement on the method there described has been invented and patented in England, by Miles Settle. His method is to put the exploding cartridge in a larger one, from the sides of which it is held equidistant by wires, the outer one being filled with water. This is intended to prevent any flame communicating with either gas or coal dust, thus eliminating all danger of explosions.

The *Coal and Iron Trades Review* describes some experiments made at the Prodmore Hall collieries, North Staffordshire, in one of the most fiery coal seams in Staffordshire.

The explosion used was "dynamite gelatine," and several shots were fired in plain sight of the experimenters, and though some brought down coal and others blew out, in no case was any flame from the explosion visible. No note was made of the relative effectiveness of the safety cartridge, but it was noted that the coal brought down had a very small proportion of "smalls." As the general effect of all nitro-glycerine compounds is to shatter rather than to burst, it is possible that the combination between the gases of the explosion and the steam evolved, resulted in a lower tension gas, having more of the effect of a soda powder.

On the return of the party to the surface, at dusk, a water jacketed shot was fired in a bag of coal dust without the slightest appearance of light or flame, only a cloud of coal dust. Then an ordinary powder charge was fired in another bag of coal dust, when, simultaneously with the explosion, the whole contents of the bag shot up in light flames and disappeared in smoke, the inventor receiving general congratulations.

Dominion Land Surveyors.

The fever has broken out in a new place. Even the Provincial Land Surveyors "deem it advisable for the purpose of improving ourselves and maintaining and elevating the standard of our profession, to organize an Association of Provincial Land Surveyors in Ontario.

A meeting for organization will be held at Toronto, on Tuesday, 23rd. February, 1886, at 2 P. M. Arrangements have been made for meeting in the Crown Lands Department.

It is desirable that all P. L. Surveyors shall attend this meeting, that a constitution may be adopted that will meet with the approval of the majority of the profession. Those who may find it impossible to attend will oblige the conveners by communicating their views to Willis Chipman, Brockville, Secretary pro tem.

Conveners: Otto J. Klotz, G. B. Kirkpatrick, T. H Jones, Jno. M. Moore, P. S. Gibson, G. B. Abrey, M. J. Butler, Lewis Bolton, Prof. Galbraith, Alex. Niven, Edgar Bray."

We are pleased to see the above bit of enterprise on the part of our brethren over the border. The educational requirements for a practising land surveyor in Canada far exceed any that prevail in the United States. In fact there are no "requirements" with us except a majority vote at an election, and while there is a "sprinkling" of first rate county surveyors in the States, yet as a class they cannot compare in intelligence and ability with the Canadians, who are in many cases graduates of an engineering class, and who always have to endure a three years apprenticeship and two government examinations before being allowed to practice. This apprenticeship and the examinations are in large part arrant frauds on intending surveyors; the writer passed through the ordeal, and we state, without reservation, that if the system is the same as in 1860, that it it a swindle of the baldest description. We hope that in case the Provincial Land Surveyors of Ontario succeed in organizing an association, that it will at once endeavor to bring the present system to a common sense basis.

Shall Government Departments Use Only Metric Measures Six Years Hence?

In the National House of Representatives, 6th January, 1886, the following bill (H. R., 2,119, 49th Cong. 1st Sess.) was introduced by Mr. Everhart, of Pennsylvania, who, in the 48th Congress, was a member of the Committee on Coinage, Weights and Measures, and was on the sub-committee to consider the metric system:

A BILL To establish the metric system of weights and measures in the Departments of the Government.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, from and after the fourth day of March, anno Domini, eighteen hundred and ninety-two, the metric system of weights and measures, as recognized and expressed in section thirty-five hundred and seventy of the Revised Statutes, shall be exclusively employed by the several Departments and branches of the Federal Government in the affairs of the United States: *Provided*, That in all other transactions than those in which the United States is a party, it shall be lawful to employ the weights and measures now in use.

SEC. 2. That a knowledge of the said metric weights and measures shall be taught in all the schools and colleges now under the control of the Federal Government or hereafter aided by it, or such knowledge shall be required for admission to the said schools and colleges.

SEC. 3. That all laws inconsistent herewith are hereby repealed.

The principal enactment included in this bill is substantially the same that was proposed in the draft of a memorial prepared by a committee of the American Society of Civil Engineers, and printed among its Proceedings for June, 1877 (Vol. III. p. 47). § 3570 of the Revised Statutes contains the tables of the Act of 28 July, 1866, establishing the equivalents of the metric units in terms of the old weights and measures.

Railroads in China.

The *Sun* of Jan. 23 contained an interesting correspondence on the Chinese question. We heartily second the suggestion of the writer as to the chances of the engineers, bankers and manufacturers of the United States. We give the letter as follows:

PEKIN, Dec. 1.—It has been widely published in America and Europe that the Chinese Government has recently negotiated a loan for forty million dollars from English capitalists, to be used for internal improvements, and that it had entered into an agreement with a Manchester firm of contractors for the construction of certain lines of railroad. So far as your correspondent can learn, no newspaper on either continent seems to have doubted the truth of these statements. The London *Times* has given them circulation, and yet they are absolutely without foundation.

No such loan has been made or offered, and no such contract has been authorized or entered into. It is true, however, that the subject of railroads and other improvements connected with commerce, and the national defence is receiving careful consideration on the part of the Imperial Government, but it must be understood that it does nothing in such matters directly. Its operations in regard to them are carried on by imperial command mainly through the agency of Li Hung Chang, Viceroy of the province of Chihli, Senior Grand Secretary of State, Superintendent of Trade for the Northern Provinces, Tutor to the Emperor, and, since the death of Tso Tung Tang, the hero of the Kuldjah campaign. He is incontestably the ablest, most highly respected, and most powerful man in the empire. Like his friend, Tsu Tung Tang, he claims to be "only a poor scholar of books," but he is at the same time the first soldier and the first statesman of China, and the leader of the party of progress.

The memorials submitted by him to the imperial Government in 1881, and the "Last Dying Words" of Tso Tung Tang, whose funeral services have but just closed leave no doubt as to the fact that the uses and inestimable value of railroads are fully understood by the leading minds of China. It is also certain that the Empress Dowager, the aunt, and the Seventh Prince, the father and guardian of the young Emperor, who will reach his majority within two years, are strongly in favor of the early construction of a system of railroads primarily designed for the national defence, and that they will do all they can in accordance with their system of government to promote that end.

But notwithstanding the support of these powerful advocates, public sentiment in China is not by any means unanimously in favor of railroads. Here, as elsewhere, the first great question connected with the subject is that of ways and means, and the imperial Board of Revenue, it is understood, is divided in regard to it. In addition, the Board of Censors, which seems to have the right to express its opinion unasked upon all public questions, is an exceedingly conservative body, and it is now known opposes the introduction of railroads—at least for the present. While it is not probable that they can defeat the plans of the Empress Dowager, the Seventh Prince, and the Viceroy Li, they are strong enough, backed as they certainly are by the natural tendency of the Chinese people to "let well enough alone," to induce the authorities having the railroad question under consideration to proceed deliberately and with great circumspection. But withal, the best opinion is that they will begin practical operations at an early day, and that a line from this city to Tientsin at the head of steamship navigation on the Peiho, and thence to Chin-kiang on the Yang-tse-kiang, with a branch line from Tientsin to Taku at the mouth of the Peiho, in all about 800 miles, will be the first railroads built.

Inasmuch as no loans or contracts have as yet been made, and the Chinese authorities have had more or less serious troubles and complications with the European powers, it is quite certain that the engineers, manufacturers, and bankers of the United States have just as good a chance to secure employment for their skill, experience, and capital, in connection with the construction of railroads in China, as have those in any other country. Col. Denby, the new American Minister, has arrived here, and has produced a most favorable impression upon all, whether foreign or native, with whom he has come in contact. In accordance with custom, he entertained all the American missionaries, some forty in number, at his house on Thanksgiving Day, and in addition to making them the most felicitous address, gave them a most hearty and friendly American welcome.

There is no doubt that Col. Denby is keenly alive to the importance of railroad and other internal improvements in this country, and will do all in his power to secure for his countrymen a fair share of all business connected with their construction, equipment and operation. In this he will doubtless be efficiently assisted by the powerful American house of Russell & Co., and perhaps by others on the ground.

In subsequent letters I will endeavor to give the readers of the *Sun* a brief account of the revenues of the Chinese Government from the best attainable sources, a description of the commercial resources of China, with a sketch of its form of government and administration, and also of Li Hung Chang, the great Viceroy upon whom so much depends, and of whom so much is expected in the near future.

PERSONAL.

JOHN F. ANDERSON was elected Chief Engineer of the Portland and Ogdensburg Railroad at the recent annual meeting of the company.

PROFESSOR NEWBROUGH, late Professor of Civil Engineering in Lafayette College, Pa., has entered upon his duties as engineer for the Atchison, Topeka and Santa Fe Railroad, with headquarters at Topeka.

MR. SCHUMACKER, a Civil Engineer and son of the United States Vice-Council at Lisfa, Syria, is engaged in surveying a railroad from Acre to Damascus.

GUSTAV LEHLBACH, formerly City Surveyor, of Newark, N. J., has connected himself with the firm of Lehlbach Brothers, civil engineers and surveyors of that city.

CHARLES PAINE, second Vice-President of the Erie R. R., the well known former General Manager of the Lake Shore R. R., and later of the West Shore, has resigned from the Erie to accept the management of a natural gas company at Pittsburg.

J. M. HEADLEY, Division Engineer, Illinois Central R. R., from Kankakee to Cairo, has been in the engineering corps of that road continuously from its beginning, 34 years. Can any one beat that tenure of office?

Engineers' Club of St. Louis.

ST. LOUIS, January 6, 1886.

Club met at 8.15 P. M., at Mercantile Library. President McMath in the chair, 20 members and 4 visitors present.

Minutes of last meeting were read and approved.

The standing committee on National Public Works reported:

ST. LOUIS, January 6, 1886.

To the Engineers' Club of St. Louis.

GENTS.—Your committee on National Public Works to which was referred a motion to approve the action of the Convention of delegates from Engineers Societies held at Cleveland, December 3, 4 and 5th, 1885, respectfully reports that, after due consideration it was decided not to be expedient at the present time to endorse or disapprove the action at Cleveland. We therefore recommend that no action be taken on the motion.

We have further considered the question of expense attending our work as committee, but are not able to form an estimate of cost, which will be limited to Postage and Stationary until report is made and the sanction of the club obtained.

Respectfully submitted for the Committee.

R. E. McMath, *Chairman.*

Moved and seconded that the report be accepted. Carried.

The Secretary read a letter from the Treasurer addressed to Executive Committee, showing financial condition of the Club.

Mr. Holman proposed as an amendment to Sect. 2 of By-Laws, as follows:

The annual dues shall be, for resident members five dollars, and for non-resident members four dollars. Carried.

The amendment as amended was carried by a two-third vote.

Mr. J. A. Seddon read a paper on "Some considerations of the relation of Bed to Variables in River Hydraulics," which was discussed by Messrs. Moore, Ockerson, Johnson, Johnston and others. Adjourned.

THOS. D. MILLER,
Secretary.

Liverpool Engineering Society.

The first ordinary meeting of the twelfth session was held at the Royal Institution, Colquitt street, Liverpool, on Wednesday, Jan. 13th, Mr. Coard S. Pain (President) in the chair. A paper was read by Mr. Arthur J. Maginnis, M. Inst. N. A., entitled, "A Strange Failure of Steel Boilers." Since the introduction of steel for marine boilers much has been written and disclosed about the strange freaks of the material, but as far as can be traced no similar cases of failure to those about to be described have been experienced.

The peculiar nature of the failure consisted in the steel plates commencing in two steamers (after a period of 2½ years' satisfactory working) to crack spontaneously some days after steam had been let down, without exhibiting any special reason for so doing; and as they continued to occur each time the vessel came into port, at one time in the combustion chamber plates, at another time in the furnaces, and so on, it became evident that some change was taking place in the material.

A series of extensive mechanical and chemical tests was made on strips from the cut-out portion of the plates (given in the appendix to the paper), but as they threw no light on the matter, and the cracks continued to occur, it became a matter for serious consideration whether the boilers or at least the interiors must not be condemned, and as no previous cases had occurred, considerable difficulty was experienced in coming to a decision as to what course to take. It was eventually decided to have new boilers altogether, and the wisdom of the step was soon afterwards confirmed, as it was found that the blows given when cutting off the rivets cracked and broke the shell, furnace-fronts, and other plates in a most unusual and alarming manner.

During the construction of the boilers no special means were adopted, and the steel (which was made by the Bessemer process at the works of the well-known Weardale Steel and Iron Company), working in a most satisfactory way, welding, flanging, and bending without the least trouble, the holes in the shell and other circular portions being drilled and those in the straight landings punched; the furnaces after being welded were carefully annealed to the special instructions of the Board of Trade, the work throughout being regularly inspected by their surveyors and those of Lloyd's Registry, the material being also periodically tested at the manufacturers' by both of these boards.

As the failure of the material in these boilers reveals the unpleasant fact that it is possible for steel to be used which may afterwards become treacherous, notwithstanding the extensive tests and rigid inspections now made, it will be interesting to obtain some satisfactory reason for the unaccountable change which undoubtedly took place, but as mild steel is now generally conceded to have passed beyond the tentative state, the owners of these steamers decided to again have steel boilers, but of the Siemens-Martin manufacture instead of the Bessemer, so that fortunately no additional barrier was thrown in the way of the general adoption of a material which may now justly be considered one of the highest achievements yet attained by engineering science in its endeavor to adapt to the use and convenience of man the wondrous sources of power in nature.

ENGINEERING NEWS, Three Months, One Dollar and Fifty Cents.

Illinois Engineering Society.

A circular has just been issued announcing the final arrangements for the first annual meeting of the Engineers and Surveyors at Champaign on February 10th. The following papers have already been definitely arranged for:—"Drainage," by J. R. Lewis, Piper City, Surveyor of Ford county; "The Construction and Preservation of Reservoirs for Surface Water on Farms and in Agricultural Districts," by Daniel Gordon, Moline; "Drainage Districts and the Construction of Large Drainage Canals," by A. H. Bell, Engineer of Mason and Tazwell, Piatt county, and other large drainage schemes; "The Highest Attainments in Drainage," by E. D. Shreve, Chairman Drainage Committee, Ohio Society of Engineers; "Road Improvements," by C. G. Elliott, Tonica, a practical engineer and a well known author and writer on Drainage and Road Improvement; "Pile Foundations, by F. H. Sager, Chief Engineer, Cleveland and Marietta R. R.; "City Engineering," by A. H. Bell, City Engineer, Bloomington; "Topographical Surveying," by C. W. Clark, Assistant Engineer, Mississippi River Commission; "Transit vs. Compass in County Surveying," by Geo. C. Harvey, County Surveyor, Wabash county. Several other papers are partially arranged for.

A general discussion has been asked for on each of the following topics; those intending to attend please take notice: (*a*) legal method of subdividing anomalous sections; (*b*) relations of the county engineer to the county board; (*c*) the method of procedure under the New Drainage Law; (*d*) keeping County Surveyor's Records; (*e*) fees of surveyors when called upon to give expert testimony in court.

Reduced rates have been obtained on the railroads and at the hotels, The prospects for attendance are very good; quite a number of the members of the Indiana Society have expressed an intention to be present.

Those attending are requested to bring their instruments, even if they are old; such a collection will prove very interesting; some interesting points may be brought out by observing upon a true meridian with several instruments in succession; the University has an accurate U.S. standard by which chains and tapes can be tested free of charge. Contractors, instrument makers, and all others interested in engineering matters, are invited to be present.

For further particulars address

J. O. BAKER,
Champaign, Ills.

LITERATURE.

The day of a cheap library of Engineering literature is dawning! An engineer's Field Book, which used to sell at $1.50, is now offered, with additions, for *Twenty-five cents*! There are 64 ordinary octavo pages: 19 of these are devoted to Tables relating to railroad curves and to excavation and embankment calculations. The type is clear and well printed on excellent paper. There is nothing "cheap" about the book but the price. Novels and story papers are sold by the car load: no matter how cheap the price of a professional book may be, the demand is limited; we expect, however, to make this demand a remunerative one in time. Our No. 1: "A Business Man," is not devoted to tables and calculations, but is as practical a bit of information for every day conduct of business as was ever written, and as engineers are not *always* the perfection of business men, they cannot fail to be benefited by its perusal. At thirty cents for the two books the investment is not a very risky one.

Apropos of cheap publication, we are enabled by a recent arrangement, to offer Theodore Coopers' standard specifications of "Iron Railroad and Iron Highway Bridges," at the low price of 25 cents each, at which we anticipate a steady and increasing demand, as they are decidedly the best specifications for bridge construction to be found, and at the price named it is cheaper to buy them than to copy them.

We have 173 copies of the "West Shore R. R. Engineers Tables;" they are held to the order of Mr. E. L. Corthell, and the price has been $1. We are authorized to close them out at 35 cents each, when they will be out of print. Another book which will soon be out of print is "Land Laws and Legal Decisions as to Boundaries," the price of which is $1 and only twenty-four copies on hand are obtainable. When eighty-two "Torches" for locomotive engineers are sold the light will be extinguished. The price is $1 and we offer them at 40 cents to close them out.

A limited number of the Annual Reports of the "Ohio Society of Engineers and Surveyors" are for sale at $2.17 for the set of six reports. For a circular giving contents address Benjamin Thompson, Urbana, Ohio.

The publisher of the *Sanitary Engineer* has issued the following circular: "After January 10th we will accept no subscriptions from subscription agencies or anybody else at less than our regular published prices. Our subscribers will save themselves and us trouble by dealing direct with this office, or buying the paper weekly of their newsdealer. The annoyance caused us and some of our subscribers by certain agencies compels us to adopt this course."

How Booksellers are Robbed.—In an uptown book store an ingenious contrivance for robbing booksellers can be seen. It is a box large enough to hold an unabridged dictionary. It is covered with ordinary brown wrapping paper. Strings pass over the top and sides and appear to encompass the package. In reality they stop short of the bottom, and the box can be opened readily and closed with a snap fastening. A handle is attached to the strings on top of the box with which to carry it. A man entered Dutton & Co's. store on Thursday with one of these innocent-looking packages in each hand. He stopped to look at books, and the boxes were deposited on the floor. Other customers passing by kicked against them, and in the most ordinary way the man picked them up and set them behind the counter, to be out of the way. He was careful, however, to put them behind the counter where dictionaries are displayed. Ten minutes later one of the clerks observed the man stooping over the boxes, which were still behind the counter. The clerk had no suspicion that anything was wrong, but the rascal on seeing himself observed, took alarm and walked hastily out of the store. This caused an examination to be made of the packages, which were found each to contain a big dictionary. The man had meanwhile disappeared. The trade papers have been warned, and the smart sneak thieves will be obliged to invent some new method for carrying on their business. One of the boxes would cost $1.50.—*N. Y. Tribune.*

The price of Wellington's "Economic Location of Railways," is to be $3.50. Up to 100 copies we will give to *any present subscriber* to Engineering News, who will send us *one new subscriber* with Five Dollars and the postage 20 cents, one copy of the book as soon as published. There is a possibility of the price being advanced to $4.

Waddell's "Iron Highway Bridges" maintains its deserved popularity.

Just as soon as possible, we will arrange to issue the numbers of Engineering News Popular Library each month, and we think we can promise with some confidence in our ability to fulfill the same in the near future, a very fair engineer's library for the sum of five dollars, which now costs ten times as much. In view of this, we are in the market to buy, for publication in this series, manuscript articles on engineering subjects, such as, in our opinion, are in demand. We will give no estimate of price in advance of receipt of such articles in full, as it will be submitted to the criticism of experts before acceptance.

Association of Engineering Societies. Vol. V. No. 2. December, 1885.

Contents:—"Solar Azimuths by Transit Attachment, and Base-Line Measurements by the Steel Tape," by J. B. Jackson. "Experiments to determine Frictional Resistances of Railway Trains," by C. H. Hudson—Proceedings of Societies.

In the first paper Mr. Jackson advocates the use by surveyors of the transit with a removable solar attachment, and gives his own experience in such use and the advantages of the method recommended. With this portion of his paper he gives tables of "declinations" from latitude 15° to 60°, and also a table for errors in azimuth (by solar compass) for 1 minute error in declination or latitude; both tables valuable in solar compass work.

For base-line measurements, Mr. Jackson says that the greatest accuracy, in proportion to the time and money expended, is undoubtedly obtainable by the use of the "hoop-skirt-wire" steel tape in lengths of from 300 to 500 feet, and costing for the 300 feet length from $15 to $20 with attachments. His general directions for use, testing, etc. will be printed in full in this journal, so we will say no more about them here.

The paper of Mr. Hudson records the results of a series of experiments made for determining the resistance of trains and the power of the engines. All the conditions of the case are fully given, with dimensions and weight of engines, and the gross weight of each car and its position in the train. The detail of twenty-two experiments is given, together with a summary of results. As the understanding of the final figures depends entirely upon the detailed conditions stated, we must refer our readers to the original paper which is too lengthy to even abstract in this connection.

A Report on the Terminal Facilities for Handling Freight of the Railroads entering the Port of New York; especially for those railroads having direct Western connections. Written and prepared for the *Railroad Gazette*, by Gratz Mordecai. New York, *Railroad Gazette* Publisher, 1885. 69 pp. 6 by 9 inches. Price $1.50.

The handling of freight at the port of New York is, from its enormous volume and the peculiar conditions of location, a problem of huge proportions, and one little appreciated and less understood by even the class that are supposed to have an interest in such matters. Mr. Mordecai has, by means of his report and numerous maps and plans, fully explained the terminal works and manner of transacting business of the trunk lines, terminating at New York. Each road is treated separately, and the yards, docks, grain elevators, transfer docks, etc., described and illustrated. An interesting and useful feature of these papers is the detailed recital of the organization for business in each case, and the duties of the various officials, and in some cases the employés. The freight-houses in the city of New York and on the Jersey side of the North River are included; detailed plans of the freight sheds of a number of the roads are given with sufficient clearness to practically rebuild from the data here shown. A folding map of the City of New York and its surroundings exhibits the location of freight depots and the general routes followed. The report is a useful and interesting document.

BOOKS RECEIVED.

Statics and Dynamics for Engineering Students. By Irving P. Church, C. E., Asst. Professor of Civil Engineering, Cornell University, New York. John Wiley & Sons, 1886, 9 × 6 inches, pp. 194. Price, $2.00.

Report of the British Naval and Military Operations in Egypt. 1882. By Lieutenant-Commander Casper F. Goodrich, U. S. N. Navy Department, Washington, D. C. 1883, Part I. Text. 6 × 9 inches, pp. 340, illustrated. Part II. Plates 79, 6 × 9 inches.

Ships of War, 1885. By Francis T. Bowles, Asst. Naval Constructor, U. S. N. Printed for the Navy Department by A. G. Johnson, New York. 10½ × 6½ inches, pp. 32, illustrated.

Magnetism.—Its general principles and special Application to Ships and Compasses. Naval Professional Papers, No. 13, Navy Department, Washington, D. C., 1883, 6 × 9 inches, pp. 280, illustrated.

Training of Enlisted Men. Naval Professional Papers, No 18. Navy Department, Washington, D. C. 1885, 6 × 9 inches, pp. 96.

Papers and Discussions on Engines, Boilers and Torpedo Boats. Naval Professional Papers, No. 16. Navy Department, Washington, D. C., 1884. 6 × 9 inches, pp. 219, illustrated.

Papers and Discussions on Experiments with Steel. Naval Professional Papers, No. 14. Naval Department, Washington, D. C., 1883. 6 × 9 inches, pp. 82.

Papers and Discussions on Ships, Guns and Armor. Naval Professional Papers, No. 15. Navy Department, Washington, D. C., 1883. 6 × 9 inches, pp. 119, illustrated.

The Magnetism of Iron and Steel Ships: an Explanation of the various ways in which it effects the Compass. By T. A. Lyons, Lieut. Commander, U. S. N. Naval Professional Papers, No. 17. Navy Department, Washington, D. C., 1884. 6 × 9 inches, pp. 122, illustrated.

Report of the Gun Foundry Board, organized by the President in accordance with Act of Congress approved March 3, 1884. Government Printing Office, Washington, D. C., 1884. 9 × 6 inches, pp. 130, illustrated.

CORRESPONDENCE.

Chemical Tests of Cements.

NEW YORK, JAN. 24th, 1884.

EDITORS ENGINEERING NEWS: We confess to some disappointment in the reply of Prof. De Smedt to our inquiries as published in the ENGINEERING NEWS Dec 26th, 1885. He takes up valuable space telling about testing cement briquettes while wet, to which he attaches much importance, as though it were not a matter of common information,and devotes very little space to answering our questions.

We regret that the Professor should undertake to "sit down" on us. In seeking information, we propounded a few questions to one who claimed to know considerable about the subject, and instead of getting clear conclusive answers, we are called his "contradictors."

Now, this is hardly kind in the Professor, for it has a tendency to stifle investigation. There is an I-do-not-wish-to-be-contradicted sort of an air about his reply that does not augur well for himself or the public. When person sets himself up as an authority, the public reserves the right to make him prove his claim, and to that end we shall continue to ask for such information as is desired by manufacturers of cement.

In regard to "aluminate of lime," the Professor refers us to a text-book on chemistry to prove his statement. As to "sulphuric acid," his answer is not explicit. He uses the terms "sulphuric acid," and "sulphur," as though they were substantially the same, while everybody knows that one can be eaten with impunity, while the other would bore a hole through a person's tongue. He says "the freer a cement is of sulphur the better it is." We again ask the Professor: can sulphur stay in a cement when the latter is exposed to upwards of 3,000 degrees of heat during the process of calcination? It is not true, as we stated, that, if present at all, it is in the form of a sulphate, and not harmful? He also says that one per cent. of soda or potash is beneficial, and he says that European manufacturers add that amount when found wanting. When we wrote our letter as printed in the ENGINEERING NEWS of Dec, 26, 1885, we also applied to a professor of chemistry high in authority in a New England college, for an answer to three questions. His replies are given herewith. 1st: Is there such a thing as aluminate of lime? 2nd: Can there be in a cement, as it exists, sulphuric acid? 3d: Is soda or potash in a cement beneficial? His answers were: "1st: No. 2nd: No. 3d: No one but an empiric will attempt an answer nobody knows." Now at the outset, here are two professors of chemistry that disagree, and as a manufacturer we are in doubt as to whether we gain or lose by Prof. De Smedt's suggestion of having a chemist connected with our manufactories.

We also find foreign manufacturers of Portland cement agreeing to the proposition that sulphate of lime can be added to the cement with advantage. See ENGINEERING NEWS, December 15, 1883, page 605.

The method of testing cement as adopted by Prof. De Smedt seems to us unfair provided one cares to know the relative values of different brands. He says that after removing the briquettes from the moulds, they are left in the air until set, before placing in water "until set." This may be in ten minutes, or four hours. Now every manufacturer knows that in a twenty-four hour test, the longer the briquette can remain in the air, the higher tensile strain it will withstand whether it be a quick or a slow setting cement.

If I offer a cement that sets up in thirty minutes, it is placed in water twenty three and one half hours. My competitor offers a cement that requires two hours in air and gets but twenty two hours in water. My samples test at say 65 pounds, while that of my competitor tests at 75 pounds. When my samples had been given the same time in air as my competitor's, they might have tested 90 pounds. According to the Professor's ruling, if one horse can trot a mile four seconds quicker than another, he should be set back four seconds in order to make a fair race of it. We submit that the Professor's mode of testing is not a fair one.

The Professor states that "Portland cements are unquestionably far superior to the light-burned cements. This is admitted not only in Washington,D. C., but all over the world where a study has been made of improving hydraulic cements." Let us see about this. Had the statement been put that some Portlands were far superior to many brands of natural cements, we could have accepted it; but such a sweeping assertion as we have quoted we cannot allow to pass unchallenged. A cement should be judged by the work it will do. This country consumes annually about 3,600,000 barrels of natural cement, and about 600,000 barrels of Portland. Reducing the weight of the barrels of natural cement to a Portland basis, we find 4½ barrels of natural to one barrel of Portland cement used. Now if the Portland is so "far superior" to the natural there ought to be no difficulty in pointing out, at least nine failures on the part of the natural to two of the Portlands, and even this would only make it even in that respect. We venture the assertion that an investigation would show how a far greater proportional number of failures on the part of the Portlands than could be found among the natural cements.

All that any cement can do is to hold bricks and stone together well and remain so. A mill dam is about as trying a place for cement as any. Yet we can show such work built with natural "light burned" cements that has stood perfectly for 50 years in this climate, and if it can stand 50 years, can the Professor say that it will not stand another 50 years, or 500 for that matter?

Sewers that have been built over 30 years are taken up and the mortar, made of natural cement, is found stronger even than the bricks it has cemented together.

Could Portlands have done any better? Look at the great bridges across the Niagara, Mississippi and Missouri rivers, all built with natural cements. Is there anything wrong about the masonry of these bridges? Could Portland have done any better? Now look at the work done with Portlands. Look at the cracked and checked and scaled sidewalks all over the country.

Look at the ten thousand checks running in all directions in the foundation of the Bartholdi Statue. Take all the brands of Portlands that are imported, mix up samples from each brand into a thin paste and place them in glass jars. How long before the last jar will be cracked through expansion of the cement?

It is admitted that the expansion is caused by the presence of free lime, and so according to the Professor's statement, touching this point all Portlands should be rejected.

We do not deny that the Portlands are generally better than many poor,weak brands of natural cements; but that they are better than all brands of the latter, we do deny. Where is the record showing that Portland cements can do any better work than is shown in the use of a light burned natural cement in the docks at the port of Marseilles, for breakwater piers at Port Said, at the port of Toulon, at the Mount Cenis tunnel, and the miles on miles of concrete aqueducts, that supply Paris with water? All these and dozens of other masterpieces of masonry, were built with light burned cements, and not only t at, but they contain upwards of 35 per cent. of free lime, that according to the Professor is so disastrous to masonry.

Then there is the Eddystone lighthouse, built in 1757, with mortar containing free lime to the extent of over 40 per cent. and so slow in setting as to place it among the hydraulic limes, which according to the Professors' ruling should be rejected. Yet the Eddystone lighthouse has stood for over a century, and as one writer puts it "stands unmoved as the rock it is built on." There is a vast deal of nonsense about the great superiority of artificial or so-called Portland cement over the natural production. Is an artificial imitation apt ot be superior to the genuine article? Can a man with a pug mill mix clay and carbonate of lime together in a manner superior to that done in nature's great laboratory.

Given—the proper proportions of these ingredients we contend that the natural is the superior. The artificial mixers certainly have the advantage, so far as having control of the proportions is concerned, and unfortunately for the manufacturers of properly proportioned natural cements, there are many brands, classed with them, that have been presistently urged upon the market that are over-clayed, and it is through the use of such faulty grades, coupled with that modern moloch, called the "tensile strain test," that people have been led into a belief that any cement branded "Portland" is necessarily better than any brand of natural American cement. Is it not time that some one called a halt!

This tensile strain fever is running high. It is already the "Alpha and Omega" with many engineers.

Had this "tensile strain" test been applied by the British Government at the time Smeaton built the Eddystone lighthouse, he would have had a sorry time of it, trying to convince the public that his Aberthan lime would fill the bill, for it was an hydraulic lime unable to sustain immersion until after several days of exposure in air.

We do not wish to be understood as claiming that free lime in a cement is of any special benefit, but we are willing to take the responsibility in saying, that if the lime is thoroughly hydrated before the cement is used, no injurious results can arise therefrom, as is well proven in the use of the hydraulic lime of Teil—during the past 60 years.

The Professor states that "Portland's have about 10 per cent., and natural cements about 30 per cent. of inert matter."

This is another sweeping assertion that, to say the least, is improperly put. While it is entirely correct as regards Portlands, and may be applicable to many brands of natural cement, yet there are many brands of the latter that have a less percentage of inert matter than the average Portlands.

The Professor says he "is investigating to see if alumina is absolutely necessary in order to produce a superior cement, such as the Portlands in quality."

If we may be allowed, we would suggest to the Professor, that he might find alumina to be the "inert matter" referred to, and that in no way it is a benefit to the cement.

That whenever there is silica present in excess of the proportions required to form silicates of lime or magnesia, he will find silicate of alumina, which must be counted as inert matter.

That when silica is present in proper proportions to form silicates of lime and magnesia, he will find free alumina, which must be counted as inert matter.

That when there is not enough silica present, there will be found free lime magnesia and alumina.

That it is an error to suppose that lime in excess will combine with alumina, forming "aluminate of lime," test books to the contrary, notwithstanding.

That the percentage of "inert matter" is governed entirely by the total amount of alumina present, to which must be added such silica as may be found in excess of the amount required for the formation of the silicates of lime and magnesia.

Whatever the Professor may have to say disparagingly of natural cements, it cannot be said that the manufacturers of such brands resort to the dishonest practice of adulterating their products. As is the case with the Portland manufacturers, which, according to their own testimony, is carried on to an alarming extent, sometimes as high as 50 per cent. of foreign matter is mixed with Portland cement. See ENGINEERING NEWS, December 15th, 1883, page 605, and January 9th, 1886, page 22.

The Professor closes with an expression relative to the manufacture and exporta ion of American Portland cement. We fear the Professor will never live to see that day.

The history of American Portlands has been such as to discourage such an idea. Nearly every attempt to manufacture Portland cement in this country has met with disastrous failure, not because they could not produce it cheap enough, nor good enough, but because it was not *importea*; it was not "English, you know." There are suspended Portland cement works in this country to-day, that when in operation made just as good Portland as any ever imported judged by analyses and tensile strain tests, but the engineers would not use it in important work; they were afraid to. A prejudice so fixed and rooted in favor of something foreign, is an obstacle the Professor would find require more than one generation to overcome.

MANUFACTURER.

Water Pressure in Mains.

CITY HALL, CAMBRIDGEPORT, MASS., JAN. 25, 1886.

EDITOR ENGINEERING NEWS: I am interested in your table of pressures, published in ENGINEERING NEWS. Please inform me in some way, how it happens that the day pressure is greater than the night pressure, if there is any other way, than that the standpipe is used in day time, and not at night. (?)

Please inform me how it happens that a difference of 20 lbs. exists between the day and night pressure, as seems to be the case in Bristol, Pa. I know, under ordinary circumstances the pressure should be greater at night when less water is being used, than during the day when the largest quantity is being used, but it seems rather too much at 20 lbs.

Yours truly,

JOHN L. HARRINGTON.

[We leave it to be answered by water works superintendents.]

Bridge Information Wanted.

NO. 5, KAGA YASHIKI

TOKIO, JAPAN, December 16, 1885.

EDITORS OF ENGINEERING NEWS.—Being in need of some information which I can obtain in no other way than through the courtesy and generosity of the members of our profession in America, I ask you to do me the favor to insert this letter in your paper.

Situated as I am some seven or eight thousand miles from the manufacturing centers of America, it is extremely difficult for me to obtain data that I find to be essential for my investigations in bridge designing. This must be my excuse for troubling you and your readers.

Although I am aware that some engineers object to furnishing information for the use of others, both on account of the trouble involved, and from the mistaken idea that in parting with his knowledge for no immediate pecuniary return, one is a loser; nevertheless, I do not hesitate to ask for information, because I am always ready and willing to aid in this way any member of the profession who may apply to me.

The data that I wish to obtain are included under the

nine following headings; and I shall be very much obliged to anyone who will aid me concerning even a single item of one heading.

1st. History of iron bridge construction in America (especially railroad bridge construction).

2nd. Tables and diagrams of sections of all the shape iron suitable for bridges that is rolled in America, excepting those of the Union Iron Mills, New Jersey Steel and Iron Co., and the Pencoyd Iron Works.

3rd. Tables and diagrams of all sections of steel suitable for bridges that are rolled in America, together with any data concerning the strength, stiffness, elasticity and proper intensities of working stresses for same.

4th. Limiting lengths, widths and thicknesses of all sections of iron and steel suitable for bridges that are rolled in America, also the variations in prices per pound for the different lengths, widths and thicknesses.

5th. Present prices of iron and steel sections of ordinary dimensions, and average prices per pound for finished bridges of iron and steel at the shops.

6th. An approximate table of cost of turn-tables and latching apparatus for swing bridges of various lengths, for both single and double track roads.

7th. Blue prints or other drawings of the latest and most approved styles of turn-tables and latching apparatus for swing bridges.

8th. Descriptions of and data concerning existing suspension railroad bridges, or information as to where such may be obtained.

9th. Addresses of all the principal American manufacturers and dealers, who supply any materials, tools or apparatus used in bridge building; also copies of all catalogues, etc., issued by such parties.

In conclusion I would state that no one can confer a greater favor upon me than by pointing out any errors or deficiencies that may exist in either of my two treatises on bridge designing. Such matters will receive most careful attention, and will be corrected in future editions or in any other book or paper that I may write.

Yours very respectfully,

J. A. L. WADDELL.

[We trust that our readers will give Prof. Waddell all the assistance possible in the direction of his investigations, so that the good work he has already done for the profession may be still further supplemented.

EDS. ENG. NEWS.]

Nebraska News.

OMAHA, NEB., Jan. 23, 1886.

Special Correspondence ENGINEERING NEWS.

The third Annual Convention of the Nebraska Association of Engineers and Surveyors met in the County Court House at Omaha, on the 18th and 19th of January. J. P. Walton of Lincoln, President, called the meeting to order.

Reports were read by the Chairman of the different committees on legislation, highways, bridges and records, blanks and instruments. Mr. A. J. Grover read an interesting paper "On the Methods of Constructing, and the Effect of Pile Dikes in the Missouri River," illustrated by maps. He also exhibited drawings of a pile driver, designed by himself giving a complete description of it.

Mr. J. C. W. Cline, of Washington Co., read an article on "Fish Creek Improvement Ditch in Burt and Washington Counties." Map of the country drained, and photographs of the bucket dredger used were shown.

Mr. George Tilson, of Omaha, read a paper on "Sewer Drainage," discussing the different kinds, giving some facts and figures in connection with the Omaha system.

The following officers were elected for the year 1886:

President: Geo. W. Tilson, Omaha;

Vice President: G. A. Kilpatrick, Seward;

Secretary: A. J. Grover, Omaha;

Treasurer: J. P. Walters, Lincoln.

The committee on National Public Works were George W. Tilson, Chairman, A. Rosewater and C. H. Howes.

The Society adjourned to meet, in August, at Grand Island and to hold the next Annual Meeting at Lincoln in January 1887.

Mr. Parkhurst, the Superintending Engineer of the new Union Pacific bridge at Omaha, had the misfortune to break his leg about six weeks ago. This week the doctors had to amputate it.

The Iowa caisson of the new bridge is down 65 feet; only 15 feet more to rock another caisson is nearly ready to commence sinking.

The Chicago & North Western by its extension, the Fremont Elkhorn & Missouri Valley and its extension, the Wyoming Central, will in another year be most completed to Ogden, Utah. The F. E. & M. V. are now built and running to Chadron, and the contract is let for the next 125 miles to Ft. Fetterman, Wy. The general course is along running water, Shawnee creek to the North Platte river along the Platte river to Ft. Fetterman and Ft. Casper, to the Sweetwater and following it up to near its source, crossing the Oregon Short Line Railway near the western boundary of Wyoming, thence to the Central Pacific at or near Ogden.

The F. E. & M. V. branch north of Chadron has just been completed to Buffalo Gap, Dak., and is being graded to Rapid City, 112 miles from Chadron and 40 miles from Deadwood.

Articles of incorporation for a new railway, known as the Duluth, St. Cloud and Denver Railway Company, have been filed. This road, if constructed, will run southwesterly through Minnesota, Dakota, and Nebraska, with branch roads to the coal fields of Iowa. The capital stock is placed at $15,000,000. The incorporators are H. J. Rosenburger, O. W. Baldwin, D. W. Bruckart, F. E. Baldwin and John W. Rosenburger, all of St. Cloud, Minn.

Incorporation papers, of the Chicago, Nebraska, Kansas and Southwestern Railway, were filed with Secretary Roggen, January 21st. The road, if built, is to run from a point on the south boundary of the State, between Franklin and Webster counties, to a point on the Missouri river in Cedar county, opposite Yankton, via Omaha. The capital is fixed at $6,000,000, and among the incorporators are G. R. Chaney, R. V. Shirley, A. H. Kaley, E. B. Smith and ex-Governor Garber.

BEATRICE, NEB., January 22.—The proposition to vote $20,000 worth of bonds for water works for this city, carried to-day by 518 majority. The opposition was made principally by men who thought the amount too large. The bonds draw 6 per cent. and will be put on the market in about three weeks. Bids for putting in the system will then be advertised for and all work will be commenced as soon as possible. The system includes seven miles of pipe, sixty hydrants, and first-class pumping machinery and direct pressure.

Last night's blow filled up the city again and no trains are running here to-day.—

Ohio News.

URBANA, O., Jan. 26th.

Special Correspondence Engineering News.

The City Council of Portsmouth, O., have granted to the "Portsmouth Belt Railroad Company," an incorporated body, the right to construct a belt railroad in that city, free of charge, the railroads and the river will thereby be united, and the business advantages of the city greatly increased.

Hon. Leo Waltz, ex-member of the Board of Public Works of Ohio, who recently returned from Europe, says in regard to the Public Works of Ohio, "the Legislature of Ohio will make a great mistake if it gives away any part of one of its canal, for while the business of these artificial water courses is depressed just now, principally because of the failure of the State to keep up the system, it cannot remain so long if they are given any show at all." Investigation shows that business is much better on the Ohio and Mississippi, than it has been for the last few years. There is a large amount of bulky freight that need not be hurried, and can be carried as well by boat and cheaper. Fruits so transported are fresher, and not so badly shaken up. Railroad corporations want to see the canals go, because the latter are their greatest enemies, and it is noticed that since our canals, inefficient as they are, closed, freight rates have gone up. "In Germany the canals are kept in the very best state of repair, and on the highways over which a great part of the empire's productions are borne to the cities and other markets, those leading into Berlin are constantly covered with boats, and the boatmen are never idle." Mr. Waltz advocates that "only thoroughly practical engineers should have charge of the canals, they should be made, after the State has changed its attitude toward these watery highways, to devote their entire time to them, and should be paid according to their qualifications and the work done."

The last idea has the right sound, and engineers' organizations are making efforts to meet the practical managers of public works half way in the effort to adjust salaries to qualifications and work done.

Captain Stoddard, a lake navigator, has projected a line of lake passenger steamers, to ply between Toledo, O., and Buffalo. He is confident that it will be profitable, and will engage in the business as soon as the necessary stock is subscribed.

The Pan Handle Railway Company is completing arrangements to build a road from Red Banks, a point on the Little Miami road, seven miles above Cincinnati, to Hamilton, in order to strike their main line at Richmond over the C. H. & R. The length of road to be built is about 20 miles.

About a year ago Lima, O., voted $200,000 to build water works under an estimate that such an amount would complete a system reaching every part of the city. Work was begun last spring, the city dug up and rendered nearly impassable, and now it is found that $175,000 more will be required to complete the works.

Tiffin, and Belle Centre are reported to have struck natural gas in paying quantities.

The Wheeling and Lake Erie railroad is to be sold to pay first mortgage bonds, in accordance with the decree of the Circuit Court at Cleveland, O.

The Auglaize river, in Allen county, Ohio, is to be improved for a distance of about 8 miles by widening, deepening and removing all drifts.

The Massillon Bridge Company, Massillon, Ohio, was awarded the contract for two highway bridges across the river at Grand Rapids, Mich.; each bridge is to consist of four spans of 150 feet, with 24 feet roadway and two 8-feet sidewalks.

Indiana News.

Special Correspondence ENGINEERING NEWS.

There is considerable opposition in La Fayette to the rebuilding of the bridges, two highway and one railroad, as directed by the U. S. Army engineers. The engineers claim that the bridges should have a swing span, or be raised, so as not to interfere with navigation; the La Fayette people claim that the river is not navigable, that "in a dry time there is only water enough to float a canoe," and that they will not rebuild the bridges until compelled to.

The "Big Four" railroad is making arrangements to replace, during the coming summer, all their wooden bridges with iron ones, at an estimated cost of $100,000.

J. J. Daniels, of Rockville, Indiana, has just completed the masonry for the Bedford and Effingham (narrow gauge) railroad bridge over the Wabash at Merom, Ind., the Keystone Bridge Company are on the ground, preparatory to putting the superstructure in place.

Indianapolis is discussing the question of sinking the railway tracks below the surface or of building viaducts over them.

R. D. Smith, of Terre Haute, has petitioned the county commissioners for the right of way to build a "horse railway line" from that city to Macksville, 9 miles, over the county turnpike.

The O. and M. Railroads has just closed an agreement with the citizens of Washington to concentrate at that place its machine shops and car works, now located at Cochrane, Seymour, and Vincennes; the latter are to pay $75,000 toward the construction of the new buildings which are to cost not less than $150,000; work to commence on or before April 15th next.

The Notre Dame College will introduce the incandescent electric light into all college buildings, in parlors study halls, private rooms, etc.; at least 500 lights will be required.

Cross ties are cheaper in Indiana that they were five years ago, notwithstanding the decrease in timber and the increase in value of lands. Contractors are paying but 28 cents a piece for ties 6×8 inches, by 8 feet long.

It is said that there are English steel rails in Wabash track which have been in service 19 years, and still show but little signs of wear.

Illinois News.

CHAMPAIGN, ILL., January 26., 1886.

Special Correspondence ENGINEERING NEWS.

A Chicago firm of engineers have sent circulars to various parts throughout the state, proposing to make a special survey and contoured map of a township, provided the township officials will take one large map and the property holders a certain number of smaller ones. The circular claims that in a township surveyed and mapped in this way there need be no further expense for engineering in laying out roads and drains.

Champaign and Jacksonville are considering the advisibility of using electricity instead of gas for street lighting, and are willing to hear the propositions of different companies. Joliet has decided by a vote of the City Council to light the place with electricity instead of gas.

The Taylorville City Council contracted for water works, to be paid for by issuing bonds; the mayor was opposed to the scheme, on the ground that they cost too much, and resigned, thus leaving no one to sign the bonds. There are a number of towns in this State which have recently contracted for water works, being convinced that they will prove good investment.

The Mattoon Coal Company contemplate the construction of an escape shaft to their mine as soon as work can be commenced in the spring; it will be located north of the town, about a mile from the main shaft, and is estimated to cost $20,000.

A movement has just been started in Warren county, to improve the Henderson river for drainage purposes.

At the meeting of the Tile Maker's Association, it was estimated that 15,000 miles of tile had been laid in the state in 1885, which will probably be exceeded this year. In Douglas county, with an area of only about 300 square miles, and which is neither swampy nor specially wet, although flat, 6,000,000 feet were laid. The following were average prices for tile during the past year. For 3-inch tile, $11.97 per 1,000; 4-inch, $17.01; 5-inch, $24.16; 6-inch, $34.65; 7-inch, $41.68; 8-inch, $56.10; 9 inch, $71.69; 10-inch, $92.06; 12-inch, $129.81.

A wooden highway bridge of 125 feet span, over the Sangamon river, seven or eight miles south of Mechanicsburg, Sangamon county, has been washed away by highwater.

The C. R. I. & P. is understood to be talking of building into St. Louis in the spring.

At Minonk, the Western Edison incandescent system of electric lights is being put into residences. The citizens have taken one hundred and two lights of sixteen candle power, each at thirty-five cents per month for the summer months, and fifty cents for the winter.

The Peoria Water Board has awarded the annual contract for 1886 for cast-iron pipe and special castings to the Cincinnati & Newport Iron Company, of Newport, Ky., at $27.89 per ton, and $48 for special castings. The contract will amount to $110,000.

Princeton claims to have put down more miles of good brick pavements during the past year, than any city in the state, and the good work will be continued until brick pavements are laid on every street in the city.

The following shows the cost of brick pavements laid in Jacksonville, during the past summer,

NORTH MAIN STREET—4068 SQUARE YARDS.

Brick, 444,473 @ $9.92 per M	$4.410.0
Commissioners making assessment	30.00
Fees and cost	29.40
Stakes	16.50
Engineer and Assistant	181.85
Sand	160.68
Freight on same	255.91
Cinders (net)	353.43
Laying pavement	948.15
Printing	4.40
Excavation	338.14
Curbing	1,734.80
	$8,463 27
Cost per square yard	2.08

SOUTH MAIN STREET—1,664 SQUARE YARDS.

Brick, 181,811 @ $9.92 per M	$1803.98
Commissioners	30.50
Engineer and assistance	92.33
Fees and costs	130.65
Printing	8.40
Sand and freight on same	113.54
Excavation	85.05
Cinders (net)	94.07
Laying	360.30
Curbing	420.85
Stakes	6.15
Total	$3,145.79
Cost per square yard	1.89

The City Controller of Chicago has completed his estimates of the city expenses for the coming year. The total is $5,006,716. Of this amount $1,232,714 is apportioned to the Department of Public Works. The Police Department is the next most expensive on the list, the figures reaching $1,096,102. The Health Office is put down for $241,386 and the Fire Department $714,835. The Controller's estimate of the city's resources foots up $6,442,009, of which $4,687,265 will, it is expected, be derived from taxes and $1 338 634 from water rates. Receipts from various licenses are estimated at $1 855.718 practically all of which is from liquor licenses.

Carter S. Harrison is to be continued as Mayor of Chicago.

WATER

THE St. Louis *Westliche Post* has compiled from German papers some interesting facts about the price of gas in some of the chief cities of Germany. In American money the price per 1,000 cubic feet is in Berlin $1.02; in Hamburg, 82 cents; in Bonn, 82 cents; in Dresden, 74 cents; in Breslau, 74 cents; in Duesseldorf, 74 cents, and in Cologne, 61 cents.

THE system of water works at Fond du Lac, Wis., constructed by the Holly Manufacturing Co., of Lockport N. Y., for the Fond du Lac Water Co. was successfully tested on January 15 and 16th, and has been formally accepted by the city. The system consists of 14 miles of pipe, with 140 fire hydrants, two Gaskill compound pumping engines, each of 3,000,000 gallons daily capacity, pumping station and impounding reservoir of 2,500,000 gallons capacity. The supply which is ample and of excellent quality, is taken from four artesian wells, 600 feet deep, and the company commence the supply of that city under favorable auspices with good prospects of success. Fifteen 1-inch streams were thrown at once to a height of 120 feet, and one 2-inch stream was thrown 164 feet high. Numerous tests were satisfactorily made outside of the contract requirements.

Water Pressure in Mains of Various Cities.

COMPILED BY J. J. R. CROES. FROM SPECIAL RETURNS, DEC. 1885.

TOWN AND STATE.	Topography.	Difference of level in town.	In Business District.		Fire Pressure.
			Day Pressure.	Night Pressure.	
		feet.	lbs.	lbs.	lbs.
Alameda, Cal.	level.	0	35	45	80
Benicia, Cal.	hilly.	40 to 80	65	75 to 80	75 to 80
Canton, Ohio.	sloping.	10 to 25	65	65	125
Danville, Pa.	level.	0	60	60	80 to 100
Eagle Rock, Ida. Ter.	rolling.	12	12	15	45 to 95
Faribault, Minn.	rolling.	20	96	96	96
Georgetown, Tex.	level.	0	40	60	120
Hannibal, Mo.	hilly.	30 to 100	90	90	90 to 125
Ida Grove, Ia.	hilly.	100	45	45	125
Jackson, Mich.	hilly.	70	50	50	100
Kalamazoo, Mich.	hilly and level.	90 to 110	45	40	85 to 10
Laconia, N. H.	hilly and level.	50 to 60	80	82	80 to 82
Madison, Ind.	rolling.	——	45	——	45
Nantucket, Mass.	nearly level.	30	35	35	80 to 100
Oconto, Wis.	level.	0	27	27	27
Painesville, Ohio.	level.	10	50	48 to 56	85
Quincy, Ill.	hilly.	——	35	35	35
Rahway, N. J.	hilly.	——	55	55	70
Sacramento, Cal.	level.	6 to 10	30 to 35	30 to 35	60 to 65
Tacoma, Wash. Ter.	plateau.	380	65 to 90	65 to 90	65 to 90
Unadilla, N. Y.	level.	0	65	65	65
Vergennes, Vt.	hilly.	113	80	80	150
Wahpeton, Dak.	level.	0	40	30	80 to 150
Wakefield, Mass.	——	——	100	65	150
Yankton, Dak. Ter.	level.	70	37½ to 47	37½ to 47	37½ to 47

COST OF LIGHTING STREETS.—The city officials of Baltimore have been investigating anew the subject of lighting streets in order to understand why that city has to pay so much more than other municipalities in this respect. Under the contract made early last year, Baltimore's cost of maintaining street gas lamps was $36.94 for each lamp per annum, burning only on dark nights, and $46.19 if allowed to burn all night. In comparison the following figures are collected, showing the amounts paid in other cities:

New York	$25.00	Rochester	$18.12
Boston	31.85	Richmond	44.00
Washington	22.00	Dayton	21.11
New Orleans	24.00	Jersey City	25.00
Burlington	25.00	Cleveland	17.50
Auburn	17.50	Baltimore	46.19

It may be interesting also to note the amount of lighting facilities which the larger cities possess. New York has 23,038 gas lamps and 647 electric lights; Philadelphia has 13,555 gas lamps; Boston, 9,781 gas lamps and 401 electric lights, and Baltimore, 5,191 gas lamps and 243 electric lights.—*Bradstreet's.*

SYRACUSE, N. Y., WATER SUPPLY.—The plan of the committee is that the city take the plant of the present water company, the price paid therefor to be settled by a commission, if terms cannot otherwise be agreed upon. As the water company is in control of the source of supply which, it is understood, the city will want, the purchase is a necessary condition. As for the water company, its trustees ought to regard the proposition as a fair one. The report names the commissioners who will serve for four years beginning in May of this year. The people will read the list and form an opinion respecting the fitness of these gentlemen.

Relative to the permanent investment, the proposition is that a million and a half be put into plant. If all the figures that have been submitted since the bonding project was first broached have any value, it is clear that this sum will fall far short for building such a system as some of the members of the Committee of One Hundred have in mind. The water company has lately concluded, we understand, that, with the investment of a million and a half, it would increase its plant so as to meet the demands of the city. It already has several hundred thousand dollars invested, and yet its managers reckon that the completion of the system would require as much money as the Committee of One Hundred would invest, all told. Fifteen hundred thousand dollars is a good lump of money and will do for a starter, but if a complete water system is proposed, a million more will be needed.—*Standard*, Jan. 16th.

GEORGE SEYMS, who has recently analyzed the water from the new well sunk by the Plympton company, at Hartford, Conn., has found it very fully supplied with Epsom salts. This calls to mind that not long ago the Colts Arms Company shut off the city water from its factories and began using water from driven wells, and it was said when the change was first made that the water from the new source of supply contained Epsom salts.

PAOLA WATER WORKS.—Works nearly finished. Pump house finished, boilers set, pumps delayed somewhere *en route* probably snowbound. Filter crib 40 feet by 24 feet, of 10-inch square timbers, with 4-feet filter spaces on sides and top filled with sand and gravel, was built on ice; ice cut all around and filter sunk with perfect success. Stand-tower, 12½ feet diameter, 100 feet high, on hill 43 feet above city; foundation finished, about half of iron on ground, the rest delayed by bad weather. Pipes all laid but three blocks around public square. Work temporarily suspended by extreme cold, ground hard frozen 2½ feet deep. Works were to have been finished by Jan. 30th. City has granted extension of 60 days on account of delays caused by severity of season. Works will be completed as soon as weather permits, two weeks good weather sufficient, so reports to us Col. S. H. Lockett, Chief Engineer.

TO DRAIN THE "BIG PIECE."—The project of draining the Big Piece and lands adjoining, and making these lands tillable, is an old one. The Supreme Court, acting under a special law, appointed commissioners, and application is now being made to fill the vacancies in this Board, with a view to going on with the work. State Geologist Cook has repeatedly urged this, and recently there was a meeting of interested parties near Little Falls. Besides a number of property owners interested there were present Professor Cook; Mr. Worthen, hydraulic engineer, of New York; L. B. Ward, civil engineer of Jersey City; Geo. F. Howell, the ex-Assistant State Geologist, and member of the firm of Croes & Howell, who surveyed the watershed of the Passaic for the Newark Aqueduct Board; and Hilton & Menger, representing the interests of the Beattie Manufacturing Company of Little Falls. The Beattie Company is the most interested party, for the improvement will necessitate the removal of seven feet from the top of their dam, causing a loss to them of seven feet headway of water and necessitating a reconstruction of their wheels and other machinery. The Beatties do not oppose the project by any means, but naturally they will expect to be compensated. The only question is whether the lands to be given to agriculture are worth the trouble and expense of draining.—*Paterson Press.*

CHICAGO, Jan. 25.—A report of the result of his investigations of water supply and sewage problems of Chicago was made to the Chicago City Council this evening by Dr. John H. Rauch, Secretary of the Illinois State Board of Health. Dr. Rauch says: "It is beyond question that the sewage of about 80,000 persons is daily poured into the lake from Chicago, Lake View and Hyde Park. The sewage of fully 500,000 additional population for at least forty days in August, September, and November, 1885, was also emptied in Lake Michigan. Twice during this period the indescribable filth of the South Fork was swept into the same source of water supply, and during a portion of the time the contents of the North Branch were pumped through Fullerton ave. conduit into this general receptacle and fountain. It is not Chicago and the immediately subjacent territory which are alone concerned in the proper solution of this problem. The communities along the canal and river, to Peoria at least, are also interested. It is indispensable to the health of Chicago and of the towns and villages along the lake shore from Evanston to South Chicago that Lake Michigan be unpolluted, and this involves some disposition of their sewage product other than its deposit in the lake."

He recommends the immediate creation of a metropolitan drainage district to care for the sewage of Chicago and its environs.

JAMES F. LEWIS, who is connected with various engineering enterprises, while talking with me yesterday about the new Croton Aqueduct said: "The construction of this work will open the way to something new in the railroad business of New York. I expect within ten years to see this city honeycombed underneath by railroad lines. The drilling for the aqueduct has shown men what can be done in that line. One of these days men will go over into Jersey and dig down until they reach a level 100 feet below the bottom of North River. Then they will drill right through under New York, and the next thing we know all the railroad depots will be in the heart of the city. When that time comes there will be branch lines run up and down under the city for freight. The merchant, instead of sending his goods down to the dock, will take them to the nearest hole, where an elevator will lower them to the cars on the track below. It is probable that such a tunnel would be put right through under the East River also. It would be immensely profitable in that event. There are 2,000 freight cars daily sent around New York by the various roads, which are bound through East or West. It costs these roads now over $5 a car to get these trains around the city. On that basis, the tunnel could start with a business of $10,000 a day, for the better expedition would bring it all the business."—*N. Y. Tribune.*

LAST week we published an item from a Pittsburgh paper relating to an action at law on account of the Newark, O., Water Works. We take the following item concerning the same subject from the Newark, O., *American* of the 14th: "Legal proceedings have been begun in the Court of Common Pleas by the Newark Water Co., represented by Robt. F. Mullins, its Secretary, against the City of Newark, Hinds, Moffet & Co., and the Newark, Ohio, Water Works Co., which, in importance, promises to exceed that of any case tried in Newark for many years. The petition contains some nice legal questions, and if the position taken by the plaintiff company is sustained, it will involve the contractors and those interested in the defendant company in serious difficulties. Briefly, the petition alleges that the Newark Water Co. was granted a franchise January 23d, 1882, to build and operate water works in the City of Newark, and that it has ever since and at all times has been ready and desirous of performing its part of the contract, but has been prevented and estopped from so doing, by the refusal on the part of the City of Newark, to conform to certain conditions of the franchise or contract, which were essential and necessary to enable the Newark Water Co. to make its plans, order its material, and proceed to construct its works. In view of this it petitions the Court to declare the subsequent franchise granted to Hinds, Moffet & Co. null and void, and to sustain the one granted to the Newark Water Co. in 1882. It also asks for an award of damages in the amout of $100,000.

While it is hardly likely that the court will entertain the question of damage, which is probably little more than a legal formality, the question as to who is entitled to operate water works in Newark is one of great moment to the new company, which has nearly completed its works, and would sustain great loss if it is decided that the old franchise is still in force.

Aside from the questions which interest the contending companies more than the city, it is only right to say that this complication should stand as a warning to other cities, and teach them that contracts of such importance should be made only after due deliberation and then lived up to strictly.

The plaintiff company is represented by Birdseye, Cloyd & Bayliss, of New York, and Judge Gibson Atherton, of Newark."

SPRINGWATER, N. Y., is agitating the subject of water works.

A WATER POWER SUIT.—The suit of the Niagara Falls Hydraulic Power and Manufacturing Company against John F. Quigley has been up for trial. The plaintiff brought two suits for rental of power on a written agreement to run 45 years. In the first suit the company demands judgment for $3,305.35, and in the second $1,200. The defendant denies that he was supplied with power as per agreement, and by the company's failure to supply it, he lost equivalent to $300,000 and a like failure to supply power from May 3, 1884, to recent date has caused him a similar loss, making $600,000 in all.

THE BRENHAM, TEXAS, WATER COMPANY is suing the city of Brenham to enforce payment for public water supply. The majority of the City Council will not recognize the contract made by their predecessors last year, claiming that the works have not been constructed properly, and that the city is unable to pay the price stipulated, viz.: $3,000 per year, as the city charter does not provide for a tax to meet the expenses, etc.

The water company claim that they have complied with their contract and that they should be paid according to its terms and conditions. The muddle has been going on for several months, but the water company have supplied the fire department.

THE Pittsburg Water Committee has authorized its clerk to advertise for bids for a new pumping engine for the Herron Hill reservoir. Superintendent Brown has stated that the engine in use at present is worn out and not the capacity for growing supply. It was formerly used at the old Lawrenceville works, and can only pump 1,000,000 gallons in twenty-four hrs. Mr. Brown thinks that an engine which can pump 4,000,000 a day ought to be purchased. The contract must be awarded before the first of next month in order to get it in the Appropriation ordinance; hence, the haste for the bids. Bids will be solicited for all kinds of engines that have a capacity for 4,000,000 gallons a day, so that all bidders will have an equal chance.

WATER FAMINE ALONG THE NEW AQUEDUCT.—Since the explosion of dynamite at shaft No. 14, on the line of the new aqueduct, the insurance agents who have placed policies on the property in the vicinity of any of the shafts, have been notified that the companies would not take any more risks after the expiration of the present policies. There are twenty-four shafts running through Westchester county from the Putnam county line to High Bridge, and at each shaft there is a dynamite and powder magazine. It will therefore be seen that a wide strip of property in the vicinity of the new aqueduct cannot hereafter be insured. All the wells within ¼ of a mile of the aqueduct on both sides are dry. The springs have also dried up, and the farms and villages are without water. The shafts and tunnels which are being dug on an average of 150 feet under the surface, have drained the entire country, and the people have to go in some places a mile for water.

CLEVELAND, O., WATER-WORKS.—The total cost of the Cleveland water works up to the beginning of the present year, is as follows:—

West Side reservoir (6,000,000 gallons capacity) and grounds (6 acres)	$ 84,853.13
Engine house and grounds at old River street and old river bed (4 acres)	54,356.45
Two engine houses containing four pumping engines (space for two more,) providing for daily pumping capacity of 70,000,000 gallons	250,069.97
Four engines and boilers with a daily pumping capacity of 40,000,000 gallons	278,309.20
Lake crib, shaft, and tunnel, 9,220 feet long, five feet four inches in diameter, with a daily delivery capacity of 40,008,000 gallons	508,819.51
Pipe system	2,665,906.30
Water meters	32,815.14
Fairmount reservoir, with 75,000,000 gallons capacity	353,949.91
High Service reservoir, 35,000,000 gallons capacity	128,350.02
High Service engine house and engines of 6,000,000 daily capacity	190 844.74
Total cost	$4,569,374.38

During the year, 18 miles and 3,218 feet of pipe were laid and relaid. Of this amount, 4 miles and 2,791 feet were in the high service district. In the low service district 253 new hydrants were set.

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

The Gulf, Colorado and Santa Fe R. R. is contemplating an extension of the main line from Fort Worth north to Kansas City.

The Chattanooga Western Railroad directors have begun preliminary steps for building the line to the top of Walden ridge.

The Chesapeake and Ohio Railroad is to be extended from a point on the main line, near Gordonsville, Va., to Alexandria and Washington—distance to Washington about seventy-five miles.

The Helena and Red Mountain Railroad is about half located, though progressing slowly on account of the extreme cold. As soon as the work is completed the same party will locate a line from Helena to Great Falls.

The St. Paul, Fort Snelling & Minneapolis Railway Company has been incorporated. Capital stock, $500,000. Among the incorporators, who are all St. Paul men, are N. P. Clarke, William Cullen, Albert Schaeffer, L. Schurmetter, William Dawson, Jr., William Hamm and J. T. Gratten.

The Grand Rapids and Indiana R. R. Company will commence as soon as the weather permits to survey two or three routes for a new road direct from Grand Rapids to Muskegon, and the most feasible one will be selected.

The Louisville and Nashville and Richmond and Danville R R's will build a new independent line of road from Loudon, Kentucky, through Taswell, Knoxville and Maryville, Tennessee, to Toccoa, Georgia. A force of hands is at work surveying the line from Loudon.

The South Bend and Benton Harbor Railway Company has been incorporated, with a capital stock of $150,000. It proposes to build a road from South Bend, Ind., to the western limit of St. Joseph county, near Buchanan a distance of fourteen miles.

The Most Northern Railroad in Europe.—A railway is projected, which will be the most northern one in the world. It will be in Norway, and twenty-eight miles long, crossing the Kjolen mountains at an elevation of 1,600 feet above sea level. The railway is being built by English engineers for the North of Europe R. R. Co.

The Delegates of the German Railway Syndicate have left Venice on their way to China. They are M. Erich, of the Berlin Comptoir d'Escomste; M. Textor, of the Deutsche Bank, and M. Bethgelp, of the firm of Krupp. It is proposed to construct immediately five lines, uniting the following towns: Tientsin and Pekin, Tientsin and Shanghai, Tientsin and Chingkiang, Nankin and Shanghai, Canton and Nankin, Pekin and Muekeen, on the Gulf of Petchili. The first four lines will run along the coast, and will connect Pekin with the south of the Empire. The railway to the Gulf of Petchili will be in the main a stragetical one.

The Hoosac Tunnel.—The following table gives the principal data in regard to the Hoosac Tunnel:

Canal tunnel first proposed	1819
Surveys made for canal	1826
Troy & Greenfield Railroad chartered	1848
Surveys made for first railroad tunnel	1850
Work first begun on railroad tunnel	1851
Final opening from East to West	1874
First train through	1875
Total length, feet	25,081
Width of rock excavation, feet	24
Height of rock excavation, feet	20
Width of brick arch, feet	26
Height of brick arch, feet	24
Total length of brick arching, feet	7,573
Average thickness of arching courses	6
Number of brick used in arching	30,000,000
Central drain dimensions two feet square	
Grade at portals above tide-water, feet	766
Grade per mile from portals to central shaft, feet	26
Distance from east portal to central shaft, feet	12,837
Distance from west portal to central shaft, feet	12,244
Water running through drain out of west end, gallons per minute	725
Water running through drains out east end, gallons per minute	95
Depth of central shaft, feet	1,028
Dimensions of central shaft, feet	15 × 37
Depth of west shaft, feet	318
Dimensions of west shaft, feet	10 × 14
Lowest elevation of mountain above tunnel	800
Highest elevation above tunnel, feet	1,718
Number of tons of rock excavated	2,000,000
Number of pounds tri-nitro-glycerine	500,900
Distance from Boston to tunnel, miles	136
Distance through tunnel to North Adams, miles	7

The Burleigh Drill Co., of Fitchburg, Mass., issue a neat little pamphlet entitled "A History of the Hoosac Tunnel."

The London and Northwestern have decided to relay their permanent way with metal sleepers, in place of wood. The experiments already tried have proved very satisfactory, and the manufacture of these sleepers is now being pushed forward at the Crewe Works. At present they will be put down only to where it is necessary to lay new permanent way.—*Herapath's Journal.*

The Richmond and Danville R. R. Company's Engineer, Mr. A. Campbell, has put a corps of engineers in the field to survey a railroad from the present terminus of the Western North Carolina Railroad at Murphy, to Cleveland, Tenn., to connect there with the East Tennessee, Virginia and Georgia system, and thence to Dayton, Tenn., to connect with the Cincinnati Southern R. R.

The Little Rock and Hot Springs Railroad, capital $1,000,000, has been incorporated. The president is Joseph Reynolds, of Chicago: Secretary and Treasurer, M. N. Pierce, of Hot Springs; Directors—Joseph Reynolds, J. N. Conger, of Hot Springs; John M. Moor, of Little Rock. The proposed road is to be a direct line between Little Rock and Hot Springs, fifty miles in length, and will run through Garland, Saline and Pulaski counties.

An American-Chinese Railroad Company.—The papers for the incorporation of a company to build a railroad in China have just been forwarded to Albany, to be filed with the Secretary of State. The Gould-Sage-Field clique will control it. The Chinese Government is determined to have the road built, and the only question is now whether the English-German syndicate will get the contract, or the Americans. A representative of the Americans is now on his way to the Celestial Empire to close the negotiations.

The Kansas City, Des Moines and St. Paul Railway Company has been incorporated in Iowa to construct and operate a line from Des Moines to Kansas City, with the right to acquire the property and franchises of the Des Moines, Osceola and Southern Railroad, which is now constructed for over 100 miles in the direction of Kansas City. The officers of the new company are F. M. Gilbert, President, and Forhay Walker, Secretary.

The Cost of Fighting Railroads.—Attorney General Stockton's annual report, just presented to the Governor of New Jersey, reviews the litigation with the Reading and other railroads over the new tax law The expense to the State of those suits thus far has been $43,178.61, made up as follows: Counsel fees, $18,439.83; engineer and expert testimony, $15,138.91: printing returns to writs, testimony, briefs, etc., $5196.60; fees of masters, courts, stenographers, and other expenses of taking testimony, $4,403.27.

To Build an Extension to Kansas City.—The directors of the Chicago, Milwaukee and St. Paul Railroad Company recently decided to build the contemplated extension to Kansas City. The proposed road is about 200 miles long, and the cost, aside from terminals at Kansas City, is estimated at about $18,000 a mile. It was said by a prominent officer of the company that the Chicago and Pacific Western Division mortgage provided for an extension to Kansas City, and that an issue of bonds under that mortgage would be made. The authorized issue is $20,000 a mile. Work will be begun shortly on tunnels and such other sections as permit operations in the winter. It will be pushed during the open season.

"It will require eighteen months," it was said, "to build the road in the most economical manner, but it might be considered necessary to hasten construction for the sake of gaining manifest advantages.

The Hawkesbury Bridge, New South Wales.—A cablegram from New South Wales, on January 27th, announced to the Union Bridge Co., of this city, that their bid had been accepted for the construction of the Hawkesbury bridge. This is a railroad bridge across the Hawkesbury river, about thirty miles from Sidney, New South Wales. There were sixteen bidders from England, Germany and the United States. The London board of experts estimated the cost at about $3,000,000, but the Union Bridge Co. put in a bid of a little over half that sum and have secured the contract. The substructure, which will be the deepest bridge foundation in the world, has been sublet to Anderson & Barr, of New York. The work is to be completed in 2½ years. There will be 5 spans of 416 feet each and 2 spans of 408 feet each center to center of piers. The piers will be of stone founded on elliptical iron caissons; the deepest foundation is 210¾ feet below the bridge floor, or 126 feet below the river bed. The bottom is mud and sand, and the piers will rest on a hard sedimentary deposit found at the depth named.

Consolidating Railroad Embankments.—The Chief Roadmaster of the French Government Railways states that the best plant yet discovered for consolidating the loose soil of a newly made embankment by the interlacing of its roots is the double poppy. The ordinary grasses or clovers employed for the purpose require, he says, several months for the development of their comparatively feeble roots, while the double poppy germinates in a few days, and at the end of three or four months its roots are a foot long and tightly interlaced.

New Croton Aqueduct Bids.—The following are the totals of the bids for constructing Sections 12, 13 and 14 of the New Croton Aqueduct opened on the 20th at the office of the Commissioners. The Contracts were awarded on the 28th, as shown by figures in heavy type.

Contractors.	Section 12.	Section 13.	Section 14.
Rogers & Co	$376,310.00	$458,050.00	$680,430.00
Beckwith & Quackenbush	401,000.00	457,375.00	665,840.00
O'Brien & Clark	**430,345.00**	476,475.00	705,712.00
Arnold & Stevens	442,666.25	501,927.50	748,197.50
Jno. Cox & Co	443,185.25	501,081.25	712,901.25
Collins & Farwell	446,702.50	465,641.25	687,625.00
Douglass, Dalzell & Douglass	449,629.75	478,020.00	731,356.50
Page, Smith & Carey	459,361.25	440,937.50	650,652.50
P. P. Dickinson	470,107.25	——	——
Broadhurst & Lentz	493,222.50	494,925.00	——
M. S. Coleman	520,650.00	524,200.00	777,915.00
Brown, Howard & Co	521,185.00	543,750.00	802,612.50
Smith, Ripley & Casement	530,711.50	483,662.50	708,617.50
Malone & Mathews	552,625.00	428,304.75	632,452.50
Jno. Brunton & Co	——	**418,565.00**	**619,115.00**

Harlem River Bridge.—The *N. Y. Tribune* of January 26-27, is responsible for the statement that the contract for the Harlem Bridge has been awarded to the Union Bridge Co., of this city. The proposed structure is to be composed of three arches, each 280 feet span in the clear; four piers, 50 feet wide each; two abutments, 380 and 335 feet long, making a total length of 1,755 feet. The roadway will be 50 feet wide with two sidewalks, each 15 feet wide. The height is 145 feet above tide-mark. The bridge is to be finished by June 1, 1888, and is estimated to cost $2,680,000. As stated, the contractors are to be paid monthly for materials, rents and all expenses, and an additional 10 per cent. on total cost, as compensation for the contractors' services.

The Hudson Bay Railroad exploration party has returned. The line is quite practicable, the rock and earth work being light, with no heavy bridging nor any work of an exceptional character. It may be considered an easy line to construct, the country being level and of a sand or gravel formation. The only rock met with was at the southern end of the line. The timber is not of a large size, but sufficient was found for all immediate requirements. The Nelson river terminus is very favorably situated, being a large flat, well drained and about ten feet above high water. Major Jarvis was accompanied by R. J. Money, C. E., assistant to Mr. Shelford, the well known English engineer, and Mr. Money is also perfectly satisfied with the feasibility of the scheme. The total distance walked over was upwards of a thousand miles, of which about half was done on showshoes. The whole length of the proposed railway from Sea river to the terminus chosen at the mouth of the Nelson river is about 310 miles. The cost is put at about $7,000,000.

The Savannah, Dublin & West. Short Line Ry. Co. of Ga.—This company is preparing to build their line in a rush. One corps of engineers in charge of Mr. J. P. Claybrook, and one in charge of Mr. F. Tutwiler are running a preliminary line between Dublin and Savannah. Another corps, in charge of Mr. C. M. Craig, is making the final location between Dublin and Macon. A large force of convicts is now at work, on this part of the line and twenty miles of grading is completed. As soon as the line is located from Dublin to Savannah, the company propose to contract the grading, masonry, etc., and say that they will show the people of Georgia something never seen before, namely, 300 miles of railroad completed within sixteen months. The chief engineer is Arthur Pou, and headquarters Savannah, Ga

CONTRACTING.

There is no single class journal in the United States read by so many contractors for all kinds of Civil Engineering construction as ENGINEERING NEWS AND AMERICAN CONTRACT JOURNAL. *We propose as in the past to publish early intelligence of all new contract work. Our prices for advertising proposals for contracts is twenty cents per line, and it is so cheap that parties having any work to advertise will always find it a good investment to use this journal.*

Tunnel Contract.—The Board of Directors of the Northern Pacific Railroad Company have let the contract for the tunnel, two miles in length, through the Cascade mountains, to Nelson Bennett, of Deer Lodge, M. T. The tunnel will cost something under $800,000, and is to be completed by May, 1888.

Street Paving.—Six contracts for grading, paving and curbing amounting to about $40 000, were awarded at East Saginaw, Mich., to Scanlan & Crowley, of that city, January 18th. The other bidders were John C. Davis, of East Saginaw; Peter Malcolm, of Saginaw City, and Hurley Bros., of Bay City, Mich.

The prices, at which the work was let, are as follows:

Paving (6-inch cedar block, 1-inch board, 3-inch sand)	69 to 71 cts. per sq. yd.
Paving (same, except using manufactured sapless blocks)	79 to 83 cts. per sq. yd.
Excavation	18 to 25 cts. per cu. yd.
Embankment	15 cts. per cu. yd.
Curb (4 × 18 Medina sand stone)	47 to 50 cts. per lin. ft.

The city has decided to use the manufactured cedar block, as by the process of manufacture, all the sapwood is removed from the block, and the pavement is expected to last much longer. The increase in cost over ordinary cedar blocks is only about ten cents per square yard.

Railroad Contract—ST. LOUIS, Mo., January 24.—Contracts have been let to Colonel L. L. Bush, general manager of the Kansas, Wichita & Dakota north and south line, and Erskine Smith, for the construction of the Bald Knob spur of the Iron Mountain R. R., from Bald Knob, Ark., to Memphis. The spur will be nearly 100 miles long, and the work on it will be commenced in a short time.

Jail.—There was an exciting contest to secure the contract for the erection of the new court-house and jail at Marfa, Texas, recently made capital of Presidio county. Nineteen contractors contested and the bids were closed. Colonel J. H. Britton and Alfred Giles, of San Antonio, were the most reasonable bidders, and the fight lies between the two, and will be decided by the County Commissioners Court, February 8. The two buildings will cost $75,000.

Iron Pipe.—These awards for iron pipe have been made by the Philadelphia Water Department: To the Mellert Foundry and Manufacturing Company, twelve-inch pipe, at 1.25-100 cents per pound; Emaus Iron Company, of Lehigh county, four, six, eight and ten-inch pipe, respectively, at 1 295-1000, 1 25-100, 1 206-1000 and 1 206-1000 cents per pound; Gloucester Iron Company, sixteen-inch pipe, at 1 253-1000 cents; twenty-inch pipe, at 1 21-100 cents; thirty-inch, at 1 20-100 cents; thirty-six-inch-pipe, 1 20-100 cents; forty-eight-inch-pipe, 1 20-100 cents small special sizes, from six to sixteen inches, at 2 10-10 cents per pound; large special size from twenty to forty-eight inches, at 2 25-100 cents per pound, and R. D Wood & Co., breeches pipe, at 3 80-100 cents per pound.

Water Pipe.—The following are the bids for 3,000 tons of 36-inch cast-iron water pipe for water mains received by the city of Milwaukee:

Lake Shore Foundry	$25.35
Dennis Long & Co., Louisville	27.10
Warren Foundry and Machine Company, Phillipsburg, N. J	26.40
Cincinnati and Newport Iron and Pipe Company	24.75

The contract was awarded at the last bid per ton.

The following bids were received by the city of Milwaukee for 1,500 tons of water pipe of various sizes: Lake Shore Foundry, $25.35 per ton for 30-inch pipes, $26.35 for 20-inch and 24 inch, $27.45 for 12-inch, and $28.05 for 8-inch and 6-inch; Dennis Long & Co., $27.38 for 30-inch, $28 for 20-inch, 27.58 for 24-inch, $28.75 for 12-inch, $29.75 for 8-inch, and $30.75 for 6-inch; Detroit Pipe and Foundry Company, $26.36 for 30-inch, 20-inch and 24-inch, $29.86 for 12-inch, 8 inch and 6-inch; Warren Foundry and Machinery Company, $26.99 for 30-inch, $27.40 for 20-inch and 24-inch, $28.20 for 12-inch, 8-inch and 6-inch; Cincinnati and Newport Iron and Pipe Company, $24.74 for 30-inch, 20-inch and 24-inch, $25.94 for 12-inch, $26.44 for 8-inch and 6-inch. The last bidder received the contract. The delivery is to commence April 1, 1886, and must be finished by August 1st.

City Engineer Benzenberg states that the city has saved over $10,000 by contracting for the pipes so early in the season.

Market Report of Engineering Materials.

New York, January 28, 1886.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles		1.95 @	2.00
Tee		2.25 @	2.35
Beams and channels American		3.0c. @	
Tank		2. @	2.1c
Shell		2.4c. @	2.5c
Steel plates, Tank		2½c. @	
WROUGHT-IRON PIPE.. PITTSBURGH.			
Butt welded, black	Discount	42½ @	45
" " galvanized	"	32½ @	35
Lap welded black	"	60 @	62½
" galvanized	"	45 @	60
Boiler tubes	"	55	
RAILS.			
Steel (large lots at mill)		$34.00 @	35.00
Old rails		22.00 @	22.50
Old rails, steel		22.00 @	23.00
R R. spikes		2.25c.	
R R. splice-plates		1.70 @	1.75
R R. Track Bolts Square Nuts		2.75	
Barb-wire fencing, galvanized			5.00
" painted		4.00 @	4.25
Corrugated iron			
Nails			
Iron, per keg		2.65 @	2.75
Steel do.		2.50	

METALS.

COPPER.			
Lake Superior		$11.40 @	11.55
Other Brands		10.30 @	10.45
LEAD.			
Com. Domestic		4.65	4.67½
Lead Pipe		.06½c.	
Tin-Lined Lead Pipe		.15	
Sheet Lead		.07¼	
ZINC.			
Sheet		$5.15 @	5.45

BRICK.

Cargoes afloat)			
Haverstraw	per M.	$8.00	
Fishkill			
Up-River			
Jerseys			
Long Island			
" pale		4.00	
FRONTS.			
Croton, red		11.00 @	14.00
" dark		11.00 @	14.00
" brown		10.00 @	13.00
Philadelphia pressed		24.00 @	25.00
Trenton "		24.00 @	25.00
Baltimore "		37.00 @	41.00
Buff "		33.00 @	35.00
Enameled English		65.00 @	130.00
" American		85.00 @	120.00
Fire brick		24.50 @	55.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

Alsen's Portland Cement Works	$2.50 @	$3.00
BAETJER & MEYERSTEIN:		
Hanover Portland	2.00 @	2.65
BELLONI & Co.:		
Hemmoor "Crown" brand		2.50
JAMES BRAND:		
K. B. & S	2.55 @	3.00
BROOKS, SHOOBRIDGE & Co.,	2.45 @	2.60
HOWARD FLEMING:		
Gibbs' English Portland, 400 lbs	2.65 @	2.90
K. B. & S. " "	2.75 @	2.95
Stettiner, German	2.65 @	2.85
Lagerdorfer, "	2.45 @	2.75
Fleve, A 1, Belgian	2.35 @	2.50
Roman	2.75 @	3.00
Keene's Coarse	4.75 @	5.50
" Fine	7.75 @	8.50
" Superfine	8.50 @	10.00
FISHER, ERSKINE W.:		
Stettin (German) Portland Cement	$2.40 @	2.75
GABRIEL & SCHALL:		
Vorwohler "Lion"	2.65 @	3.10
HUDSON RIVER CEMENT Co. Rosendale		1. 0
JOHNSON & WILSON:		
Saylor's American Portland	2.15 @	2.40
LESLEY & TRINKLE, Philadelphia, Pa.:		
"Giant" Portland	2.20 @	2.40
Improved "Union"	1.25 @	1.50
Union	1.10 @	1.20
MARCIAL & Co.:		
J. B. White & Bros. Coarse	4.50 @	5.00
" Fine	8.00 @	10.00
" Portland	2.45 @	2.85
NEW YORK CEMENT Co.:		
Rosendale		1.20
N. Y. & ROSENDALE CEMENT Co.:		
Rosendale, "Bridge" brand		1.10
SINCLAIR & BABSON:		
K. B. & S	2.35 @	2.60
STANDARD CEMENT Co.		
E. THIELE:		
Dyckerhoff	2.90 @	3.25
UNITED STATES CEMENT Co.:		
Windsor	1.00 @	1.10
Standard		1.15
Cable's Portland	2.15 @	2.40
UNION AKRON CEMENT Co.:		
Akron "Star" brand.		

ASPHALT.

Prices range per ton	$15.00 @	20.00
According to quantity or brand, and whether taken from vessel or store.		

LIME.

Rockland, common per bbl	1.00	
" finishing	1.20	
State, common	.90	
" finishing	1.10	
Kingston, ground	95 @	1.00
Add 25c. to above figures for yard rates.		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.		0.95 @	1.00
" " No. 2 "		0.75 @	0.85
" " light drab "		0.80 @	0.95
Berlin " in rough "		0.75 @	1.00
Berea " " "			
Brown stone, Portland, Ct. "		1.00 @	1.35
" Belleville, N. J. "		1.00 @	1.35
Granite, rough		0.45 @	1.25
Common building stone per load		2.00 @	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.		0.40 @	3.00

SLATE.

Purple roofing	per square	6.00 @	7.00
Green	"	6.00 @	7.00
Red	"	15.00	
Black Penna. (at New York)	"	4.50 @	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box	per M.	18.00 @	20.00
Choice	"	65.00 @	70.00
Tally plank, 1¼ in. 10 in. dres'd, each		.44 @	.50
Tally boards, dressed com.	"	.28 @	.30
SPRUCE, Boards dressed	"	.25 @	.28
Plank, 1¼ in	"	.28 @	.30
" 2 in.	"	.38 @	.40
" 2 in. dressed	"	.43 @	.45
Timber	per M.	20.00 @	22.00
HEMLOCK, Boards	each.	.18 @	.20
Joist, 2½ × 4 to 4 × 6 in		.16 @	.44
OAK	per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2½ in	"	35.00 @	40.00
YELLOW PINE, Girders	"	25.00 @	30.00
Dressed flooring	"	28.00 @	35.00
SHINGLES, Extra shaved pine, 16 in.	"		
" sawed 18 in.	"	5.75 @	6.00
LATH, Cargo rate	"	2.25 @	2.30

PAINT.

Lead, white, American dry per lb	.04¼ @	.06
" in oil pure "	.06½	
English, B. B. in oil "	.08¼ @	.08¾
Red, American "	.05¼ @	.05½
Litharge "	.05 @	05½
Venetian red, American "	.01 @	.01¾
Indian red "	.05 @	.10
Vermillion, American lead "	.10½ @	.12½
Paris green "	.15 @	.20
Umber, Amer. raw and powdered per lb.	.01¾ @	.01¾
Drop black, Amer. "	.07 @	.13
" " Eng. "	.11 @	.13
Chrome green "	.05 @	20
Oxide zinc, American "	.03¼ @	.04
" French "	.06 @	.08

Trade Notes.

THE rails for the Portland and Willamette Valley Railroad, Oregon, 2,100 tons, at $56 50 per ton delivered in Portland, have been ordered in Philadelphia.

THE Western Steel Co., of St. Louis, are making extensive improvements in the steel-rail department, preparatory to restarting the same. They expect to be making rails in a few weeks.

RATES on pig iron from southern furnaces have been advanced on the basis of 50 cents per ton to the Ohio river, above present figures, which is now on the basis of $2.25 from Chattanooga, thus making the rate to Cincinnati and other Ohio river points $2.75 per ton. A corresponding advance will be made to all other points.

THE BASIC PROCESS.—This year's make of basic ingot iron amounted to 609,183 tons containing under 0.18 per cent. of carbon, and were used in the manufacture of wire, tin, plates, tubes, sleepers, boiler and ship plates, etc. The makes of the various countries included under the above gross total were—England, 148,707 tons; Germany and Austria, 617,514 tons; France, 130,582 tons; Belgium and other countries, 51,514 tons—total, 945,317 tons. Out of the foregoing England made 70,803 tons containing less than 0.81 per cent. of carbon; Germany and Austria, 424,862 tons; France 62,390 tons; and Belgium, etc., 42,118 tons, giving the total of 600,183 tons.

TO TEMPER STEEL.—The steel is generally first hardened by heating it to a cherry red, and then plunging it into cold water. Afterward the temper is drawn by moderately heating the steel again. Different degrees of hardness are required for different purposes. For very pale straw color, 430 degs., for lancets. A shade of darker yellow, 450 degs., for razors and surgical instruments. Darker straw yellow, 470 degs., for pen-knives. Still darker yellow, 490 degs., chisel for cutting iron. Brown yellow, 500 degs., axes and plane-irons. Yellow, slightly tinged with purple, 530 degs. table-knives and watch-springs. M. N. P. Ames, late of Chicopee, Mass., after expending much time and money in experiments, found that the most successful means of tempering swords and cutlasses that would stand the United States government test, was by heating in a charcoal fire, hardening in pure spring water, and drawing the temper in charcoal flame.—Toledo Blade.

FOR some months prominent steel manufacturers of Pittsburgh, Pa., have been experimenting with and testing various processes for the making of soft steel plates and slabs, such as are used in the manufacture of steel nails. A plant for the Clapp-Griffith process has been erected at the Oliver Bros. & Phillips Works, of that city, and also at the Bellevue, Ill., steel works, both of which are successfully turning out soft steel, remarkable for its adaptation to the purposes intended.

THE following table shows the countries from which our supply of foreign iron ore was obtained in the fiscal year ended June 30, 1885, with the quality and value of the ore imported from each country:

COUNTRIES.	Tons.	Dollars.
Belgium	1	16
France	4,674	14 700
French possessions in Africa and adjacent islands	25 300	48,146
Germany	2,350	3,891
England	11,800	34,206
Scotland	504	814
Quebec, Ontario, Manitoba, and the North-west Territory	47,660	170,278
British Columbia	1 962	3 724
Italy	16 213	40 125
Portugal	6,684	15,153
Azores, Madeira, and Cape Verde islands	20,647	54 972
Russia, on the Baltic and White seas	10	175
Spain	43 906	577,728
Cuba	28 500	40 948
Total	425 870	963,598

—Iron Trade Review.

THE Pratt Coal and Iron Company, Birmingham, Ala., owning the most extensive coal property in the country, has closed a trade by which it gets from the Eureka Company 500 acres of desirable iron lands. Ores from this property will feed furnaces for which the company is now building engines in Birmingham, and in connection with which the management aims to build a steel plant, the first in the South, and operate the basic process, the right to which they have bought from MR. JACOB REESE, of Pittsburg, the inventor.

THERE are some men who will not be "extinguished," but who, Phœnix-like, will rise from the apparently deadest ash heap of former glory, to astonish their friends, confound their enemies and finally conquer success. If there ever was an enterprise, which from apparently "booming success" suddenly "went out" in direst disaster, it was the E. T. Barnum Wire and Iron Works, of Detroit. But the energetic projector, E. T. Barnum, is not dead, but is out in a very lively circular announcing "that, notwithstanding these misfortunes, I have made arrangements to promptly fill orders for Wire and Iron Work that may be sent me, and that I propose, as soon as possible, to get the business in running order again," and he cautions parties ordering to address him direct at Detroit. He states also: "Circulars are being mailed by various parties in Detroit, Chicago and elsewhere, intended to mislead the trade, intimating that they are successors to the E. T. Barnum Wire & Iron Works. I desire to state I shall be my own successor and shall control and manage, myself, the business I have been 20 years in establishing. So don't be annoyed if you continue to receive such communications from others, but send your orders as usual to me, using any of my catalogues you may have, or borrow one of some hardware dealer until new ones are gotten up to replace those burned." Our own business relations with the defunct company were so satisfactory, that we are glad to be of any assistance in the re-establishment of so enterprising a business man and so liberal an advertiser as Mr. Barnum. We wish him the success he deserves.

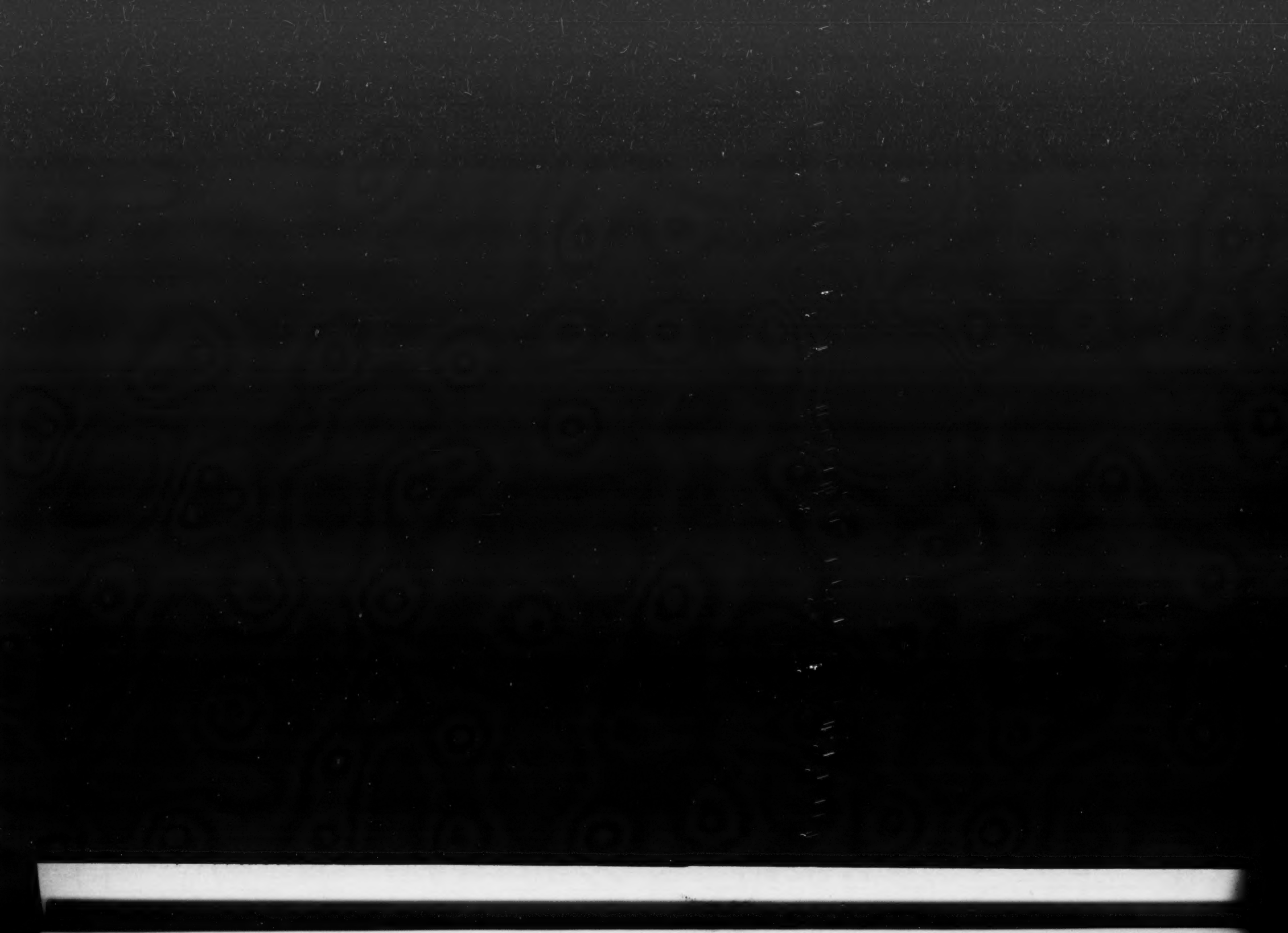
COST OF CITY GOVERNMENT.—L. S. Andrews, expert accountant, has revised from authoritative data, chiefly official documents, the comparative yearly expenditures in aggregate and per capita of twenty cities which are given in part as follows:

	Yearly expenditures.	Per capita.
New York	$48,942,178	$33.47
Brooklyn	8,248,203	12.68
Albany	1,225,307	12 37
Philadelphia	14,938,759	14.09
Baltimore	4,106,447	10.26
Washington	3,537,136	17.38
Chicago	10,195,404	16.18
St. Louis	5,596,113	13.99
Berlin	9,351,923	7.35
Average, excluding New York		11.92

The statement of expenditures in the various departments of New York and Brooklyn are as follows:

Per capita cost.	New York.	Brooklyn.
Salaries	$8.74	$4.31
Public Works	3.47	1.87
Education	3.09	1.94
Excise and Police	2.72	1.22
Fire	1.16	.65
Health	.29	.13
Law	.11	.03
Judiciary	.80	.69
Stationery	.15	.03
Total	36.57	12.68
Parks (per acre)	1.078	.163
Street cleaning (per mile)	3.166	.217

—New York Tribune.

THE soft coal fields of Pennsylvania were never under a more active development than they are this year. Large tracts are being taken up and companies formed to operate them. Spurs and branches are being built from the Pennsylvania and Baltimore & Ohio railroads to lands underlaid with coal, and many more are in contemplation. There is a perfect net-work of railroads between the Susquehanna and Allegheny rivers and penetrating the productive fields of Jefferson and Clearfield counties. The development of the Youghiogheny fields this year is expected to be extraordinary, and a line of railroad has been projected there which will give the Pennsylvania an outlet for those coals both east and west. William L. Scott is at the head of the project.

THERE will be more than 400 miles of new irrigating ditches constructed in Colorado this present winter and coming spring.